AMPHIBIANS OF WESTERN CHIHUAHUA

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ABSTRACT.—This third report on the herpetofauna of Chihuahua deals exclusively with amphibians. The first plethodonid salamander is reported, the species *Ambystoma rosaceum* is discussed in greater detail than before, and two subspecies are recognized. *Spea* is elevated from subgeneric to generic rank, and *S. stagnalis* Cope is removed from synonymy and is recognized as a subspecies of *hammondii*. The species listed include the following: 2 salamanders and 19 anurans (1 *Scaphiopus*, 2 *Spea*, 9 *Bufo*, 1 *Eleutherodactylus*, 2 *Hyla*, 3 *Rana*, and 1 *Microhyla*).

Reference is made to various habitats that are associated with elevations arising from lower deserts and extending into the western mountains. The role played by the dry and wet annual cycles is also noted.

This is the third report on the herpetology of western Chihuahua (Tanner 1985 [1986], 1987). It deals only with the amphibians. As indicated in the preceding reports, the state of Chihuahua is a large area and includes deserts on the east, steppe foothills and valleys in the central part (north to south), and the north end of the Sierra Madre Occidental in the west. This diverse geographical terrain provides numerous and multiform types of habitat.

One wishing to gain a general understanding of the terrain of southern and northwestern Chihuahua would benefit by reading the account by Goldman (1951), which deals with the explorations of Nelson and Goldman during the late 1890s. Although their activities did not include exploration of the entire state, they did include considerable travel in northern Chihuahua extending into the deserts, mountains, and valleys and to the northeast and west of Casas Grandes. The trip by Goldman from Parral to Batopilas is replete with descriptions of this extensive area. The central area west from Ciudad Chihuahua to Madera and southwest to the extensive areas north and west of Creel were not explored.

Although these exploratory field trips provided valuable information concerning the general nature of the terrain, faunas, and floras, only a relatively few herpetological specimens were collected and these were deposited in the U.S. National Museum (Smithsonian Institution). Thus, it has remained for others to explore and report the rich herpetological faunas of this state. References to other important studies are cited in the first of this series (Tanner 1985 [1986]). One cannot traverse this area without becoming enamored with its rugged diversity and beauty. There are few areas where one can stand in a coniferous forest on the rim of a mighty canyon and observe an entirely different biome approximately a mile below, where wild figs and mangoes grow along a river, which is in turn surrounded by an invading thorn forest from the bench lands of Sinaloa (Fig. 1).

The climate in Chihuahua can be characterized by its cool to cold winters (November into March), dry to very dry springs (March through June), and moderately to heavily rainy summers (July into September), although the amounts will vary greatly from location to location and from year to year. The fall months (mid-September and October) are delightful, with warm days and cool nights. As indicated below, the climate and terrain combine to provide numerous habitats and a moderately rich amphibian fauna.

During the dry season (March through June) few amphibians are seen and those only along permanent streams and springs. Much of central Chihuahua is at an elevation between 5,000 and 6,000 feet; and, therefore, it is cool to cold until May with occasional frost during April. It is not until the summer rains come, usually from July to the first part of September, that an abundance of amphibians is seen. A trip from western Durango to Ciudad Chihuahua during a rainstorm corresponded with the emergence of large numbers of frogs and toads from areas that had

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Fig. 1. View from the west rim of the Barranca de Urique east of Cerocahui, Chihuahua, Mexico.

been very dry a few days before, but teemed with life soon after the heavy rain.

The following is from my field notes taken on 24 July 1958:

> Near El Salto, Durango, about 4:00 p.m. it began to rain. We decided to return to Chihuahua City and drove through the rain until 2:00 a.m. About 18.5 miles north of Durango City (and for the next 50 miles) we encountered large numbers of amphibians on the road, in the pools along the road and calling from the entire area, in concert, but with several distinct choruses. The following were collected: *Bufo d. insidior*, *Bufo cognatus*, *Hyla arenicolor*, and *Scaphiopus hammondi*. They were so numerous on the road that we could not drive without hearing a constant "pop" as their inflated bodies were crushed.

We outran that storm but were in it again at Ciudad Chihuahua on the afternoon of 28 July. The following is recorded in my field notes:

> Packed and left Chihuahua City about 4:00 p.m. in a light rain. The rain continued and intensified during our trip to Colonia Juárez. The amphibians were seen on the road for most of the trip. In some of the valleys between Sueco and Casas Grandes, we encountered large numbers of the same species seen in Durango.

The phenomenon of amphibian emergence after heavy late spring or summer storms occurs throughout many areas in North America. Inasmuch as I have seen the same phenomenon in Kansas (summer 1948), I would classify Chihuahua as a southern extension of the areas to the north and not an exception. A similar emergence occurred in the mountains at Chuhuichupa (3 July 1958) and was repeated again at Cerocahui (17 July 1958). In both cases *Bufo microscaphus* and *Hyla eximia wrightorum* were abundant.

Careful collecting was done around most habitats, such as small mountain streams, springs, seeps at the base of cliffs, and, in general, areas that serve as salamander habitats in southern Mexico. We found only one species of salamander, *Ambystoma rosaceum*, and concluded that the radiation of plethodontids had not extended north of Nayarit.

The discovery of *Pseudoeurycea belli* in eastern Sonora (Lowe et al. 1968), and more recently in adjoining west central Chihuahua, revives the belief that representatives of the Mexican plethodontids may indeed occur in select habitats along the western front of the Sierra Madre Occidental. The western mountains, which extend north from central Mexico, have served as dispersion pathways for representatives of major groups to reach north into Sonora and Chihuahua, as may be seen in such genera as *Eleutherodactylus* (*tarahumaraensis*), *Eumeces* (*brevirostris*), and *Thamnophis* (*melanogaster*), to mention only a few. Not only have these mountains provided a series of habitats conducive to dispersion, but they have also provided places of refuge from desiccation since the last pluvial period in an area now nearly surrounded by deserts.

We did not collect in all areas of southwestern Chihuahua. Those areas near the barrancas in western Chihuahua were not extensively worked. Thus, much must be done in these areas before we can present complete distributions of the species listed in this report.

Localities we visited are listed on the map published in the first report on the snake fauna. The map has been revised for reprinting in this report. It should be noted that most records are in areas outside of towns and cities. The map provides general locations and should aid in the identification of most localities cited in the text (Fig. 2).

Since our first trip into Chihuahua in the spring of 1956, considerable change has occurred in some of the waterways. This has undoubtedly affected habitat areas along streams in the central area. Dams have been built along some streams, particularly in the fertile valleys of central Chihuahua. This occurred basically in the valleys directly east of the higher mountains to the west and has essentially eliminated some of the streams that originally flowed north into the catch basins of northern Chihuahua. Such streams as the Santa Carmen, Santa María, and Río de Casas Grandes provide little, if any, streamflow north of such towns as Rancho Flores Magon, Galeana, and Colonia Dublan. The diversion of streamflow has also eliminated most of the wetlands that were once a part of the areas adjacent to the streams.

This situation was also referred to by Conant (1974 [1977]: 485–89). To compound the difficulties, bullfrogs (*Rana catesbeiana*) have been introduced in some of the areas, thus interjecting a serious predator to other amphibians that may have originally inhabited ponds and streams in these valleys. Man's agrarian activities in these valleys and others to the south may actually provide additional habitat in some areas to partially compensate for the diversions that their activities have wrought on the northern parts of these valleys.

It should be noted that precipitation occurs in Chihuahua primarily during July, August, and early September, during which time heavy rains may occur as thunderstorms rather than as general rains that cover all or the major part of the state. These thunderstorms present a hit-and-miss pattern. Thus, the rainy season presents a climate characteristic of steppe deserts. It is during this time that the amphibians are most active, not only breeding but also, during the evening hours, feeding in open areas not always associated directly with streams or ponds. As noted above, the dry season in the spring and early summer provides little opportunity for most anurans to be active. Also, the evening temperatures may fall sharply in September or early October, thus terminating the period of activity as well as the feeding season at approximately three months for most species. In the species accounts additional ecological information is presented.

Because of the varied geographical terrain of the area studied, the amphibian fauna of Chihuahua may be placed into three rather distinct biotic groups as follows:

1. *Central Chihuahua*. This area includes the valleys, low hills, and mountain ranges lying between Highway 45 (Ciudad Juárez to Parral) and west to the Sierra Madre. This central part of the state is divided into two major drainage systems. The uplift of the Sierra Del Nido and the accompanying lower ranges extending west from Del Nido to the vicinity of Cuauhtemoc and Ciudad Guerrero serve to divide the northern system (Río de Carmen, Río Santa María, and Río de Casas Grandes) from the more extensive Río Conchos to the south and east. Extending into this central area are lower desert valleys and ranges of eastern Chihuahua (Conant 1974 [1977]). It should be noted that the Río Papigochic (a tributary of the Río Yaqui) enters west central Chihuahua through a low area in the Sierra Madre and drains some of the high valleys. The area extending north from

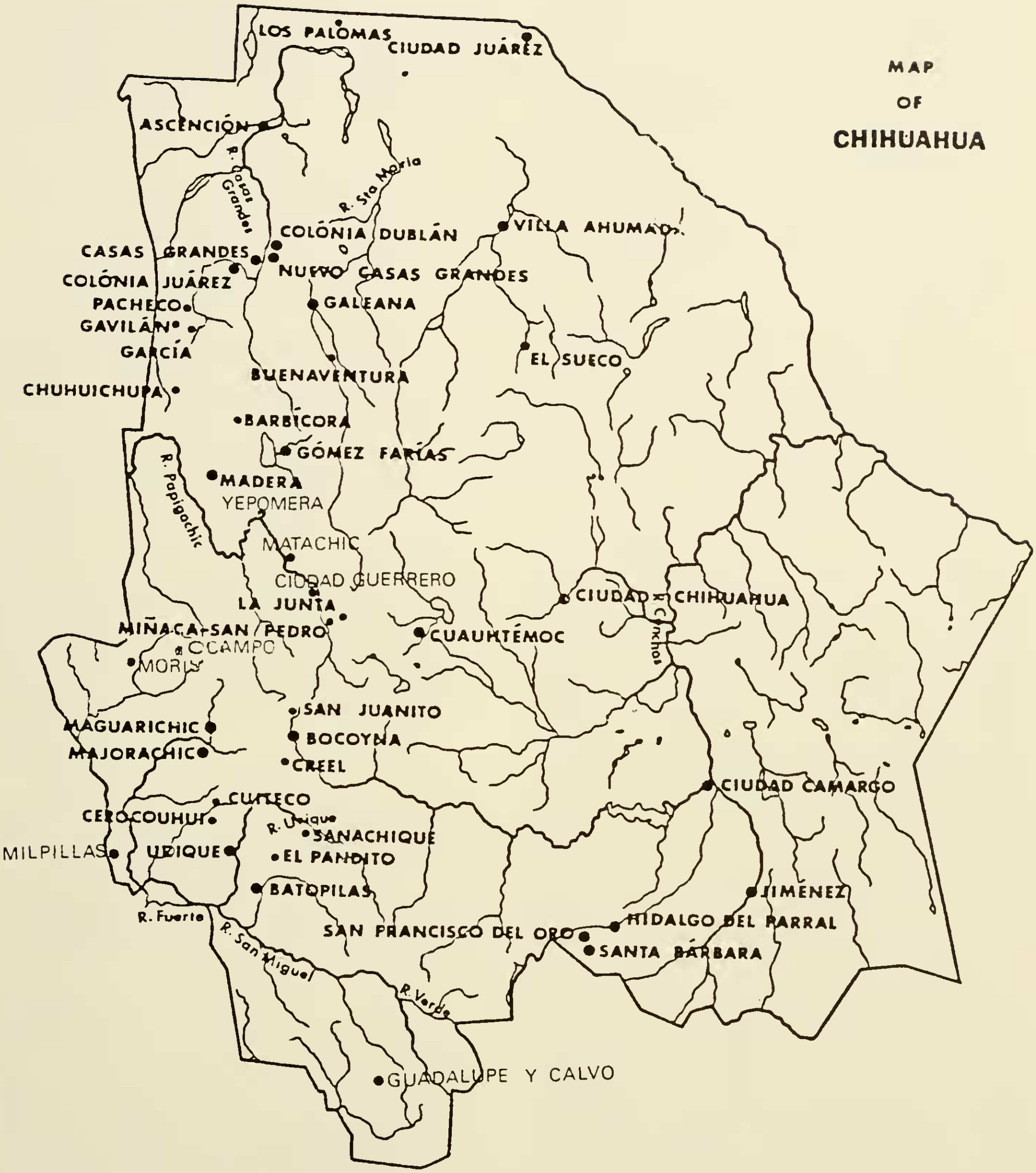
MAP
OF
CHIHUAHUA
LOS PALOMAS
CIUDAD JUÁREZ
ASCENCIÓN
R. Casas Grandes
R. Sta María
COLÓNIA DUBLÁN
VILLA AHUMADA
CASAS GRANDES
NUEVO CASAS GRANDES
COLÓNIA JUÁREZ
PACHECO
GALEANA
GAVILÁN
GARCÍA
EL SUECO
BUENAVENTURA
CHUHUICHUPA
BARBICORA
GÓMEZ FARÍAS
R. Papigochic
MADERA
YEPOMERA
MATACHIC
CIUDAD GUERRERO
LA JUNTA
CIUDAD CHIHUAHUA
R. Conchos
MIÑACA
SAN PEDRO
CUAUHTÉMOC
OCAMPO
MORIS
SAN JUANITO
MAGUARICHIC
BOCOYNA
MAJORACHIC
CREEL
CIUDAD CAMARGO
CUITECO
CEROCOUHUI
R. Urique
SANACHIQUE
MILPILLAS
URIQUE
EL PANDITO
BATOPILAS
JIMÉNEZ
HIDALGO DEL PARRAL
R. Fuerte
SAN FRANCISCO DEL ORO
SANTA BÁRBARA
R. San Miguel
R. Verde
GUADALUPE Y CALVO

Fig. 2. Revised map of Chihuahua.

Minaca to Yepomera and Madera is a part of the Río Papigochic drainage system.

Within this central area are found a series of species closely associated with the desert habitats to the north and east. The northern part of this area is basically a northwestern extension of the Chihuahuan Desert. It is our observation that the major populations of amphibians in this central area are found in the valleys, which are dry except during the rainy season but then, with the onset of heavy summer rains, literally erupt into breeding populations. This is in contrast to the few individuals seen along the small or intermittent streams during the dry season.

Those species most commonly seen in the central area are the following: *Scaphiopus couchi* Baird, *Bufo debilis insidior* Girard, and *Bufo woodhousei* Girard.

Some species have ranges that extend from the mountains into the lower river valleys and basins; *Spea hammondii* Baird, *Bufo punctatus* Baird & Girard, *Hyla arenicolor* Cope, and *Rana pipiens* Schreber are found, but our records indicate that they are less abundant in these lower valleys than are populations of these species in the higher valleys and western mountains. Records for *Rana pipiens* for 1931 are from Colonia Dublan (BYU 301 and 3657). We found them approximately 14 miles south of Casas Grandes. Bullfrogs were abundant at the river and springs near the old Rancho San Diego, downstream from Colonia Juárez. Apparently, *pipiens* had been greatly reduced or eliminated from most of the Río de Casas Grandes by bullfrogs and water diversion. This may be true for other species that were present in the recent past.

2. *Sierra Madre.* The second group, and perhaps the largest series, of species in Chihuahua occurs in the Sierra Madre. Mountain streams, meadows, and springs provide a variety of habitats that are less frequently found in the central areas of the state or are unavailable or unusable in the rapid streams of the deep barrancas to the west. The following are listed: *Ambystoma rosaceum* Taylor, *Spea hammondii* Cope, *Bufo woodhousei* Girard, *Bufo simus* Schmidt, *Bufo punctatus* Baird & Girard, *Eleuthrodactylus tarahumaraensis* Taylor, *Hyla arenicolor* Cope, *Rana pipiens* Schreber, and *Rana tarahumarae* Boulenger.

3. *Western barrancas.* In the western barrancas, particularly at Urique, two species, *Bufo marinus* and *Bufo mazatlanensis*, were abundant in the streets of the town and along the river in the evenings (14 July 1958). Other species occurring in northern Sinaloa and southern Sonora may enter the mouth of the barrancas in extreme southwestern Chihuahua. We collected one specimen of *Bufo punctatus* at Urique and a small series at Cerocahui and Cuitaco, an indication that this species has also entered the lower basins of the Río Oteros. A single representative of *Pachymedusa dacnicolor* Cope was examined by Peter Warren on 4 January 1980, approximately 5 km south of the junction of the Río Chico and Río Yaqui. This is about 50 km by air northeast of Ciudad Obregón, Sonora. Its presence in the Río Yaqui suggests its presence in western Chihuahua. From the few records available it is obvious that the areas along the state borders between Sonora, Sinaloa, and Chihuahua are not well known. Thus, the distributions of many amphibian and reptile species are not as yet defined.

SPECIES ACCOUNTS

Family Ambystomatidae

Genus *Ambystoma* Tschudi

Ambystoma rosaceum Taylor

Ambystoma rosaceum Taylor, 1941, Copeia 1941: 143–144, Figs. 1A, 1B. Type locality: Majorachic, Chihuahua, Mexico; Anderson 1978: 206.1-.2.

In small side streams of Río Bavispe, below Tres Ríos near Chihuahua-Sonora border, 4 larvae (BYU 13727–30).

Approximately 15 mi W Pacheco (Río Gavilan), 1 (BYU 16877 small adult S-V 50.8 mm).

18–20 mi from Colonia Juárez up Tinaja Canyon, 14 (BYU 14417–30, larvae).

Nortena, 5 mi NW Chuhuichupa, 35 (BYU 14432–66, larvae with one transforming–14442).

1 mi S Chuhuichupa, 8 (BYU 13942–44, 14414, 4 recently transformed adults ranging from 44.0 to 69.5 mm in S-V length; 14488–91, larvae, 30.0–42.5 in S-V length).

Black Canyon approx 8 mi W Chuhuichupa, 3 (BYU 14256–58, larvae).

10 mi NW San Juanito, 2 (BYU 14483, 15684, larvae).

8 mi SW Maguarichic, 11 (BYU 16879–89, larvae).

25 mi SE Creel, 34 (BYU 17110–28, 22771–22794, all larvae, 32.0–42 mm S-V length).

8 mi N Basihuari, 12 (BYU 22646–57, 1 adult 51.0 mm S-V and larvae 34–47 mm S-V length).

15.5 mi N Basiberachic, 11 (BYU 22747–57, larvae).

9 mi SE Colonia García, 1 (MVZ 20681, adult).

Del Nido, Arroyo Mesteno, 19 (MVZ 70554–59, adults; 68714–20, 65939–41, 70547, 70552 larvae).

Río Milpillas, 1/2 mi S Milpillas, 1 (UAZ 45882, small adult, S-V 57 mm).

Arroyo la Cienega Prieta, approx 1.5 mi N Las Chinacas (N of Milpillas), 1 (UAZ 46562, larvae S-V 55 mm).

14 mi SE Madera (Hwy 16), 1 (UAZ 34641, adult male).

4.6 mi SE Madera (Hwy 16), 1 (UAZ 34642, adult male).

Yepomera, 2 (UAZ 34777–8, adults).

2 mi S Yepomera, 1 (UAZ 34779, adult).

6.8 mi NW Yepomera, 1 (UAZ 34780, adult).

Mpio, Guadalupe y Caluo, E side of Cerro Mohinora, 3,750 ft, (UTEP 9307, 1 adult, 73.5 mm S-V, and one lot of 20 larvae).

8 mi E Guadalupe de Los Reyes (29.1 mi E Cosala, Sinaloa), 1 (UAZ 46090, this locality is approx 75 mi NW of El Salto, Durango, larva-S-V 65.2 mm).

Neviera, 4 mi W La Ciudad, Durango (MVZ 47288–9, 57274, 57276–57291, 58648–63, 65890, 22 adults and 14 larvae).

Río Hondo near Los Adjuntas, Durango, 1 (MVZ 57305, larvae).

11 mi W El Salto, Durango, 1 (USNM 154571, adult).

El Salto, Durango, 1 (USNM 123581, larva—type of *Ambystoma rosaceum nigrum* Shannon).

SW of Ciudad Durango, 1 (CAS 87350, larva).

Specimens collected in Durango are indicated; all other collection citations are from the state of Chihuahua. This salamander is present in nearly all small streams, springs, and ponds throughout the mountains of western Chihuahua. We did not find it in the larger streams and rivers where fish occurred. They are more commonly observed in habitats 6,000–8,000 feet in elevation, although some descend into the canyons and high valleys such as the Tinaja and Yepomera, to at least 6,000 feet. We observed the life history from eggs to transforming larvae and two breeding adults. Although some aspects are not yet clearly understood, the life history data available from our studies are reported in the following sections.

EGGS AND LARVAE.—Eggs were first observed on 2 April 1963 in large potholes in Tinaja Canyon approximately 18 miles northwest of Colonia Juárez. The potholes were fed by seeps along the floor of the canyon and were filled with large, embedded boulders. Eggs were found in two clear ponds, both 2–3 feet deep. In my field notes, the following is recorded:

> In two potholes there were eggs, in one they were attached between two large rocks (boulders), some were hatching, some out, others not. There were 20–25 eggs and larvae. In the second pool, eggs were laid on tree roots that were extending out and down into the pool. The eggs were attached in clusters of 2–7. On the opposite side of this pool, on the lower edge of a large boulder, 30 eggs were securely attached to the surface of the rock. None of these were hatching. In this pool, a large cluster of frog eggs (*Rana*?) was found.

Because the boulders were large and embedded, we could not investigate for additional eggs or adults that may have been beneath (Fig. 3).

On 3 April 1963, at a small spring, we found eggs and two adults. This spring and small stream is called the Turkey Tank and is a small tributary of the Río Juárez. The locale is about 15 miles southwest of Colonia Juárez and a short distance off the road to Pacheco. Only potholes were filled with water, with the small stream filtering through sand and gravel leaving little exposed water. Here, as at Tinaja, only potholes provided one to two feet of clear water, and in two of these, eggs were attached to rocks, pine needles, and other debris. Here also the eggs were in clusters of 3–4 to as many as 10–12. Some were also in strings of 3–6 eggs. Eggs were scattered over the rocks in an irregular pattern but with each cluster securely attached.

Eggs and/or large adults were not found during our field studies from mid-May to late July and August. During this time only larvae and small transforming adults were seen. Anderson (1961) states that "mating probably occurs soon after the onset of the summer rainy season, which would be any time from mid-June to mid-July in Durango and Chihuahua." I have no data for Durango, but in Chihuahua most eggs are laid during April or perhaps during early May in the higher elevations (Webb and Baker 1984). This is not to say that some eggs may not be laid during the first heavy rains of July. In our study of *Ambystoma tigrinum nebulosum* in Utah (Tanner et al. 1971) the breeding season occurred in May as soon as the melting snow filled the ponds. However, after a heavy July rain a few adults were seen in the lake, and by August we noted that there were large and small larvae. We suspect that this may occur in *rosaceum*; however, the observations of Anderson (1961) at Yaguirachic and those we have made only indicate the possibility of such an occurrence.

In Chihuahua, March through June is the dry season. During this period large larvae would have difficulty securing food in the limited aquatic habitats, but small larvae are able to establish themselves so that by the onset of the rainy season they are greatly benefited by the increased feeding areas provided by the rains. Unfortunately, I do not have precise data on the rate of growth by larvae. What is known is that eggs are laid much earlier than July and that small larvae 20–30 mm snout-to-vent length are found in May (Tinaja and below Tres Ríos). By mid-July and into August, some larvae are 45–55 mm and some are transforming into small adults with a snout-to-vent length ranging from 44 to 54 mm

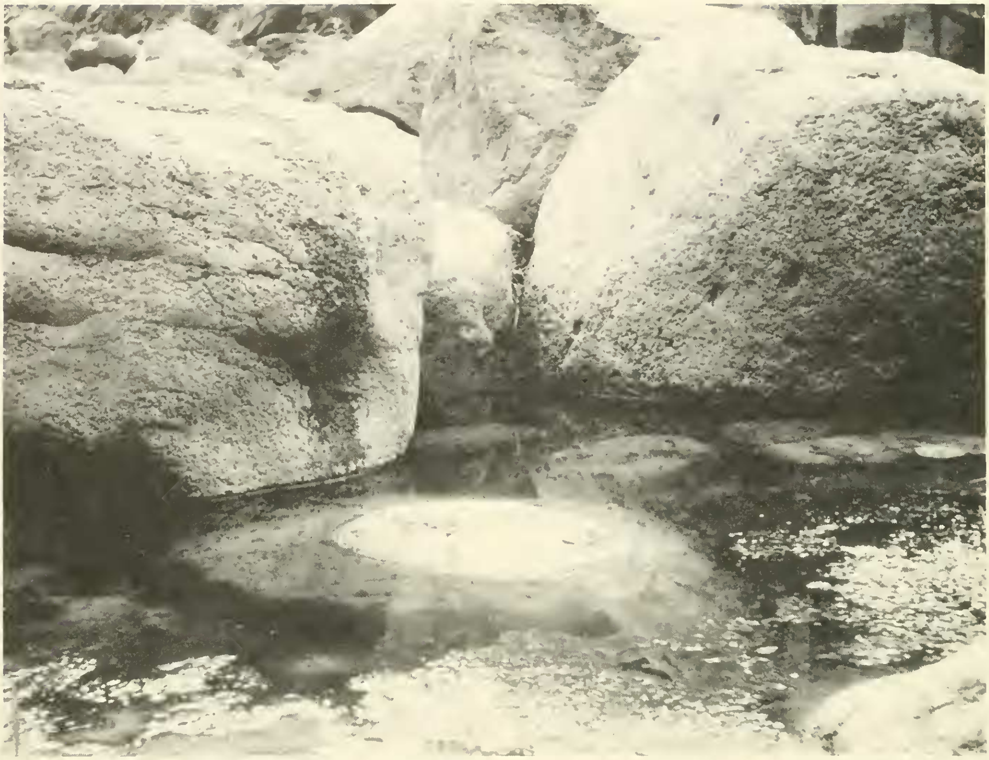

Fig. 3. An example of potholes along the streambed in upper Tinaja Canyon. This photo was taken 28 May 1956.

(Fig. 4). Our data do not indicate that larvae winter over to the next July as was suggested by Anderson (1961) and Anderson and Webb (1978). All data available to us strongly indicate that the majority of populations of *rosaceum* in Chihuahua grow from larvae spawned in April and transform into small adults before the onset of winter. Our observations of populations in the higher habitats suggest that the observations at Yaguirachic by Anderson were not at variance with ours at Chuhuichupa and that the larger larvae were probably spawned in April or early May. We did not find large larvae in any habitats (Tinaja or Tres Ríos) during April or May. I believe that *rosaceum* has adapted to an early breeding season even though the aquatic habitat in most areas consists of seeps and small streams and is thus limited in space until the rains arrive. Furthermore, small larvae would be at a great disadvantage during the rainy season when the heavy runoff usually occurs. Therefore, an early breeding season provides limited but adequate water in the habitat for small larvae. By July larger larvae can cope with the increase of streamflow and, as noted above, a greater feeding area and perhaps a greater abundance of food. July appears to be a period of rapid growth, resulting in larvae that reach their full growth and transform

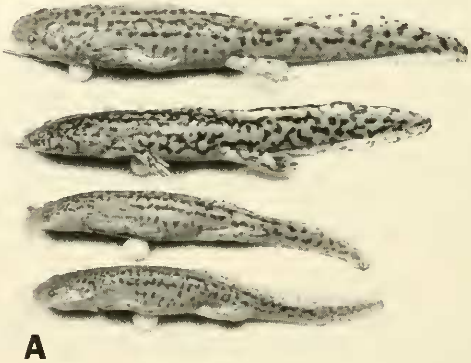

Fig. 4. Selected *Ambystoma r. rosaceum* larvae from the mountains of western Chihuahua, eastern Sonora, and Sinaloa: A, Chuhuichupa, July 1958, S-V 30–40 mm. (Figs. 4B through 4D continued on facing page.)

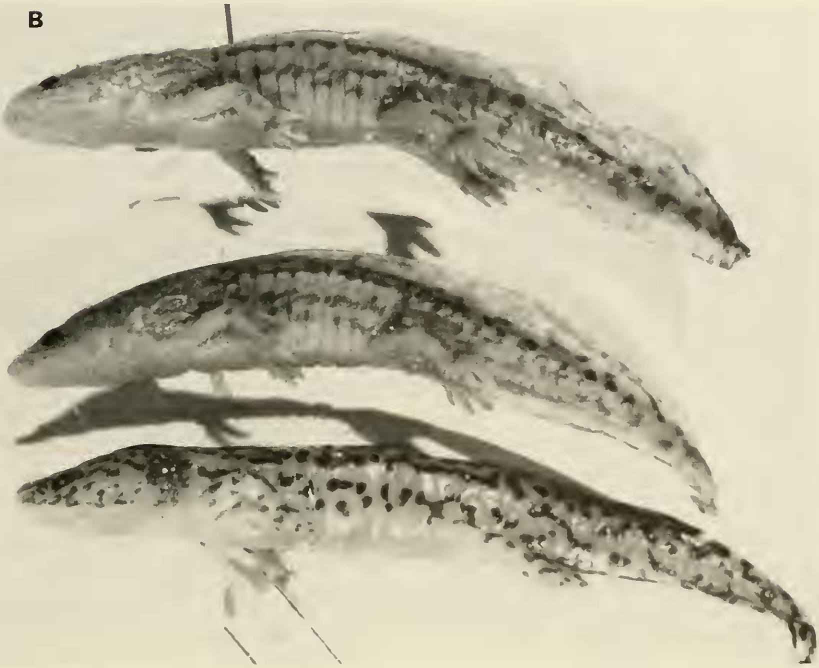

Fig. 4B continued. Chuhuichupa, 25 August 1957, S-V 45–50 mm (dorsal fin and gills reduced).

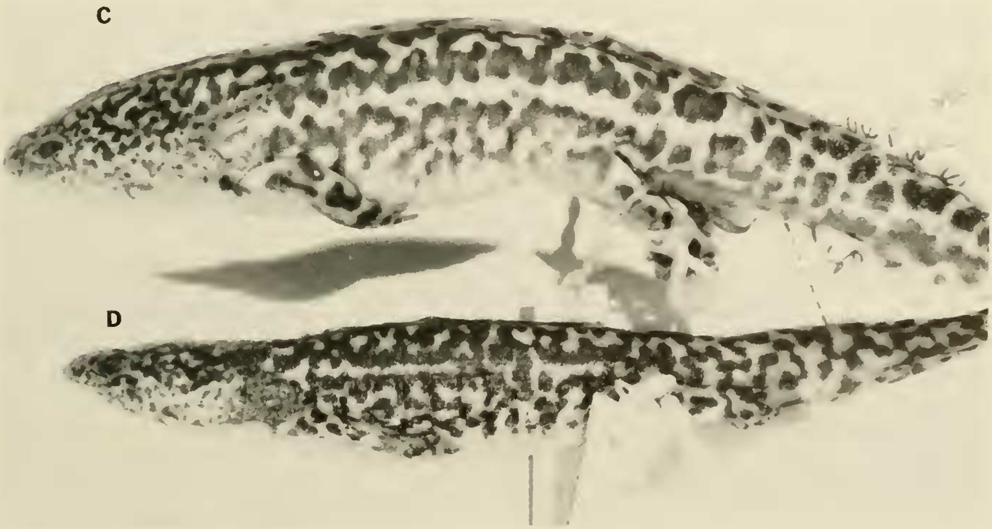

Fig. 4C, D continued. C, 25.15 mi (by road) N Yecora, Sonora, UAZ 45879, S-V 58.2 mm; D, 48.2 mi NE Mocorito along road to Surutato, Sinaloa, UAZ 46091, S-V 54.8.

during August or at the close of the rainy season in September or October (Fig. 4).

Webb and Baker (1984) found eggs and small larvae in late May. These were in permanent streams and consisted of small and large larvae (at an elevation above 10,000 ft, locality 3, northeast side of Cerro Mohinora, ca 3,750 m). As noted above, elevation may delay egg laying until May and also increase the time needed for larvae to transform.

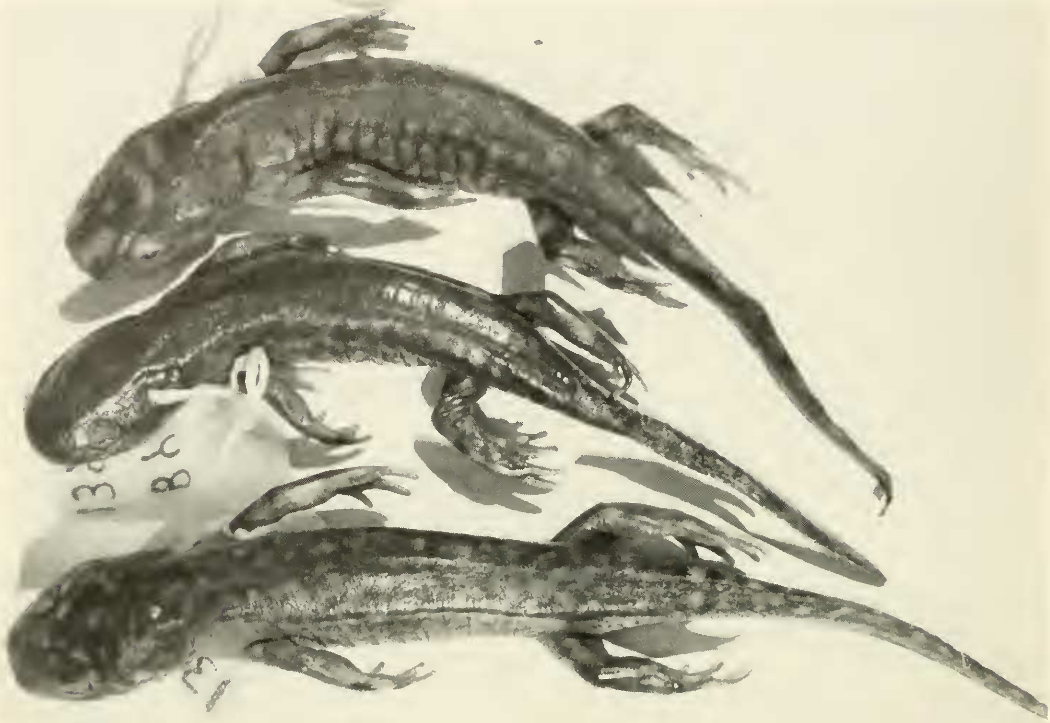

Fig. 5. Recently metamorphosed adults of *Ambystoma r. rosaceum* collected 1 mi S of Chuhuichupa, Chihuahua, 25 August 1957. BYU 13943, 13944, and 13942; S-V 45.2, 44.7, and 51.8, right to left.

NEOTENY.—We observed no neoteny in the *rosaceum* of Chihuahua between 1956 and 1972. We saw no large larvae during April (1963 and 1985) and May (1956) in habitats where we found large numbers of them in July and August. There were perhaps two basic reasons for this: It is (1) too dry to provide a habitat that would permit survival or (2) too cold to allow wintering over. Under these conditions, adults survive by burrowing, whereas neotenes cannot. Our data strongly suggest a life cycle of early egg laying (April and perhaps May) with little breeding at later dates (July), a rapid growth of larvae, particularly after the onset of summer rains, and a period of metamorphosis from mid-July into October with little or no carryover of larvae in most, if not all, habitats even in the higher mountains of western Chihuahua. That breeding larvae occur in Durango and Sinaloa is not questioned, but we did not find them in western Chihuahua and can find no data in the reports of Anderson (1961) or Anderson and Webb (1978) to support their occurrence. Webb and Baker (1984) report large larvae in late May. This indicates a wintering over of larvae but does not confirm larval reproduction since adults were also present.

ADULTS.—Two mature adults and 10 transforming or recently transformed adults were collected (Fig. 5). The latter ranged in size from 44 to 53 mm S-V, one adult 69.5 mm (Fig. 8). During late July and August numerous larvae were observed with reduced gills and the dorsal fin greatly reduced or absent from most of the body. Time limits precluded our gathering data on the length of time involved in the process of metamorphosis. Individuals with only stumps of gills were seen along the edge of the water or out on the bank.

Apparently, *rosaceum* has adapted to take advantage of the rainy season. The larvae, having reached the size and age for metamorphosis, are ready to leave the aquatic habitat while the terrain is moist. Thus, the new terrestrial habitat is less stressful, having a moist ground litter and softer soil for burrowing.

Two breeding adults were collected at the Turkey Tanks (3 April 1963). In our attempt to return them alive they died and spoiled while

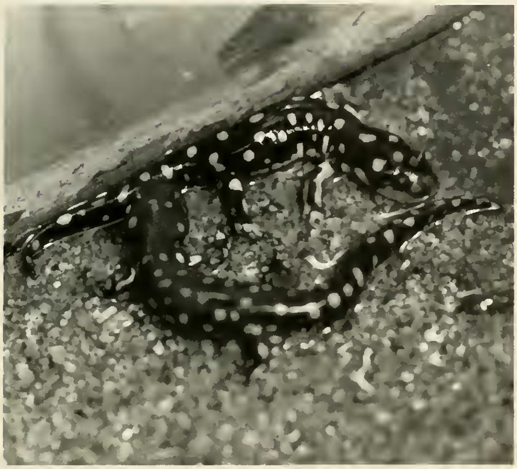

Fig. 6. Adult *Ambystoma r. rosaceum* taken at the Turkey Tanks SW Colonia Juárez, 3 April 1963.

in transit. The pair was marked with yellowish cream spots and blotches on a dark greenish ground color. Their general appearance was reminiscent of *Ambystoma tigrinum tigrinum* except that the spots were more uniformly round and small (Fig. 6). The smaller and perhaps younger adults still retained some features of the larval pattern (Fig. 5). One transforming specimen was returned alive to the laboratory where it slowly developed the yellowish spots similar to the breeding adults from the Turkey Tanks (Fig. 7). The laboratory specimens readily accepted earthworms.

The series of specimens from Guadalupe y Calvo (adult, UTEP 9307 and lot 9308, 20 specimens) is important in that all specimens are from an area in southern Chihuahua and near Durango. Furthermore, the series consists of individuals ranging in size from small larvae, less than 20 mm in total length, to a mature larva, 51.3 mm S-V with gills and dorsal fin reduced. There is also a recently metamorphosed adult 53.0 mm S-V.

The series (collected 23 May 1982) is remarkable in that it contains all stages in the life cycle. Collections made in northern Chihuahua (25–31 May 1956) at Río Bavispe and seen in Tinaja Canyon were of a nearly uniform size (30–40 mm). I have observed little variation in the color pattern of the adults and larvae from Chihuahua. The degree of pigmentation may vary, some darker than others, but the pattern is essentially the same in all. However, in widely separated populations there may be some variation in the life cycles.

SYSTEMATICS.—Dunn (1940) included six adults and four larvae from Chihuahua (no localities or collections are listed) under the subspecies *Ambystoma tigrinum velasci*

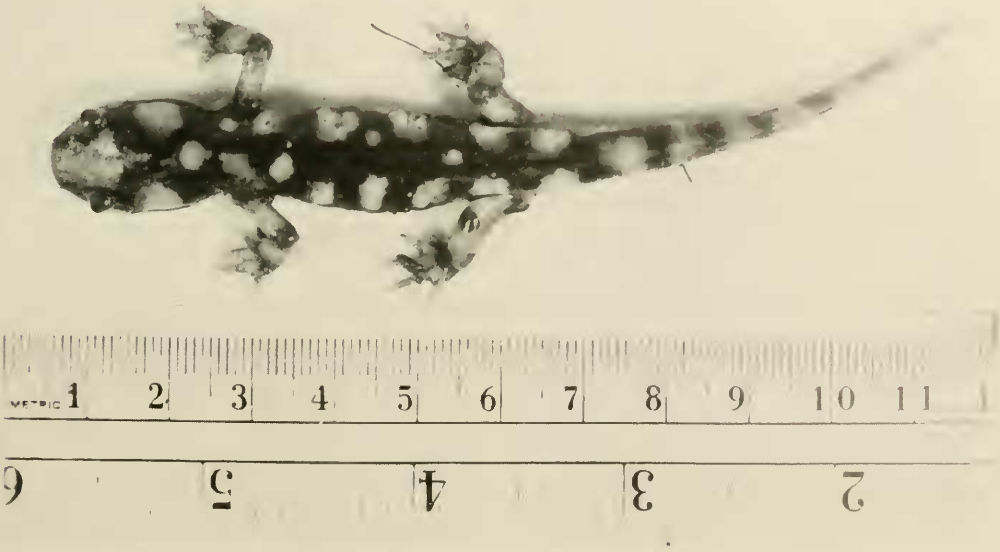

Fig. 7. Small adult collected (19 July, 25 mi S Creel) while still with gill buds and larvae color pattern. Returned to the laboratory where it developed the adult color pattern. Photo taken mid-September 1960.

Dugès. He described them as being "marked with round yellow spots and a high gill raker count" (9–15 gill rakers on the anterior face of the third arch).

In his closing remarks Dunn (1940) states, "Some specimens from Arizona and New Mexico with circular yellow spots cannot be assigned." He further states that "this form has rather large larvae with 19–20 gill rakers on the anterior face of the third arch, thus differing from *A. t. velasci.*" The specimens in question were from Prescott, Arizona (2); Río Mimbres near Deming (1), Ft. Wingate (9), Pescao (3), and Nutria (2), all from New Mexico. The location of these specimens was not indicated. It is obvious that he examined more material from Chihuahua and areas immediately to the north than had been done in previous studies.

Taylor (1941) described *A. rosaceum* (based on larval characters) and made no reference to the study by Dunn (1940). Shannon (1951) described the subspecies of *rosaceum*, *r. nigrum* from Salto, Durango, and *r. sonoraensis* from 32 miles south of the Arizona border, Sonora. Both Shannon subspecies were based on larval specimens.

Anderson (1961) reviewed the life history and systematics of *A. rosaceum*, concluding that the two Shannon subspecies were not valid. His reasoning was an extension of Dunn's (1940) concern that larval characters were not reliable in a final determination of *Ambystoma* taxa. Apparently, Anderson and Webb (1978) were still of the same opinion.

I agree with the conclusion reached by Anderson (1961) that *Ambystoma fluvinatum* Taylor is a color phase of *rosaceum*. The type of *fluvinatum* as figured by Taylor appears to be an individual in an early state of metamorphosis, with the dorsal fin greatly reduced. I have seen one of the larvae in the type series of *A. r. sonoraensis* Shannon (USNM 17255) and have compared it to specimens from the Río Bavispe drainage. In most characters there are only slight variations. However, the color pattern is of a more diffuse lateral pattern and there are fewer gill rakers (20) than in the Bavispe series (22–26).

Shannon (1951) described the color pattern as a "dark brown, ground color extends to edge of, but not or barely onto venter—otherwise pattern similar to that of *A. r. nigrum.*" We have noted significant differences in color patterns between the above description and specimens collected during our field trips into the Río Bavispe drainage system (below Tres Ríos, Chuhuichupa, and Black Canyon). We, therefore, assumed that *Ambystoma rosaceum* had developed a series of subspecies because of isolation in the major river systems. It is reasonable to suggest that the Río Bavispe, a tributary of the Río Yaqui, may contain populations as distinct as those in northern Sonora (*sonoraensis*), the Río El Fuerte (*rosaceum*), or the Durango subspecies (*nigrum*). We did describe and differentiate the larvae of the Bavispe area but hesitated to complete the report until a series of adults from the river systems are available. The teeth of six larvae were examined. The larval specimen (BYU 13727, S-V 44.7) is representative of the series and has the following: pterygoid 11, vomerine 20, premaxillary 13–14, maxillary 12–13, dentary 28, splenial 35, max-premax 35–27, dent-splenial 62.

Van Devender (1973) and Van Devender and Lowe (1977) reported the occurrence of *Ambystoma tigrinum* and *Ambystoma rosaceum* in the environs of Yepomera, Chihuahua. The adults were identified as *tigrinum* and the series of larvae taken from the streams and springs as *rosaceum*. This cells into question the presence of two ambystomid species (larvae of one and adults of the other) in the same habitat.

During a recent meeting with Dr. Charles Lowe, we examined the series of adults from the area in and near Madera and Yepomera, Chihuahua, which were reported by Van Devender (1973) and Van Devender and Lowe (1977) as *Ambystoma tigrinum*. We concluded that this series represented only adults of *Ambystoma rosaceum*. There is reason to believe that the occurrence of adults with bright yellowish spots did not correspond to the description of *A. rosaceum* as described by Anderson (1961). Furthermore, Dunn (1940) had referred spotted specimens from Chihuahua as representatives of *A. tigrinum*. Most, if not all, of the mature adults seen by Anderson (1961) were the dark subspecies from Durango, with most of his Chihuahua specimens being larval or small, recently metamorphosed adults. Thus, the finding of large greenish adults with bright, round, yellow spots was not expected to be *Ambystoma rosaceum*. Futhermore, Lowe (1964) and

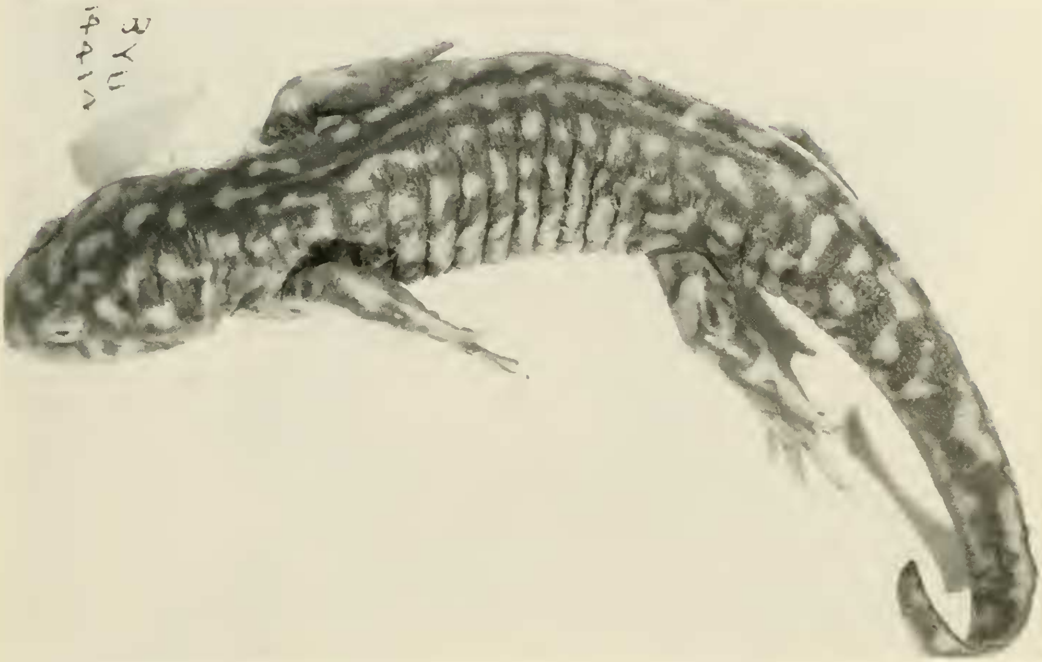

Fig. 8. *Ambystoma r. rosaceum* collected 1 mi N Chuhuichupa, Chihuahua, 2 July 1958. This was the largest recently transformed specimen collected, S-V 69.5, BYU 14414.

Webb and Roveche 1971 listed only *Ambystoma tigrinum* for Arizona and New Mexico.

The biology of *Ambystoma rosaceum* as stated above has a direct relationship to its systematics. It appears that eggs are laid in April and/or May. Larvae grow rapidly, with some reaching 45–55 mm in S-V length by late July and others by the end of the rainy season in September. Larvae begin to transform in July, retaining for a time the larval color pattern, and slowly develop a uniform darker color before the yellow spots appear that are characteristic of mature adults (see Figs. 5, 7). These data are for Chihuahua populations taken from areas west of Colonia Juárez and south to Maguarichic and areas near and southeast of Creel. Throughout this mountainous area, little variation occurred between the larval populations. Transforming specimens from Chuhuichupa and south of Creel developed similarly from mature larvae to young adults, with the mature color pattern of yellow spots appearing at 55–60 mm in S-V length.

Specimens collected at Chuhuichupa on 25 and 26 August 1957 included four recently transformed adults, 44–53 mm S-V. On 2 July 1958 we collected one specimen, 69.5 mm S-V, that still had three gill buds on each side; it was the largest one we collected or saw that had larval characters (BYU 14414, Fig. 8). These specimens were taken from and around the large springs south of town. All other larvae or transforming adults collected or seen were smaller (45–55 mm in S-V length).

A collection from 8 miles north of Basihuari (southeast of Carmen Bridge in Río Urique drainage) consisted of 12 specimens collected 4 October 1964 and included one small adult (51.0 mm S-V), one with reduced gills and dorsal fin greatly reduced (47 mm S-V), and a series of 10 larvae ranging in size from 34 to 45 mm. All were spotted and with a yellowish ground color. One can only speculate as to the age of these larvae. Other data suggest that eggs for these were laid in May. However, it is obvious that the larger individuals were transforming and that this would continue until the aquatic habitat was reduced or disappeared after the rains stopped and the soils dried.

A small adult from 1/2 mile south of Milpillas (UAZ 45882) in west central Chihuahua near the Sonora border and from the Río

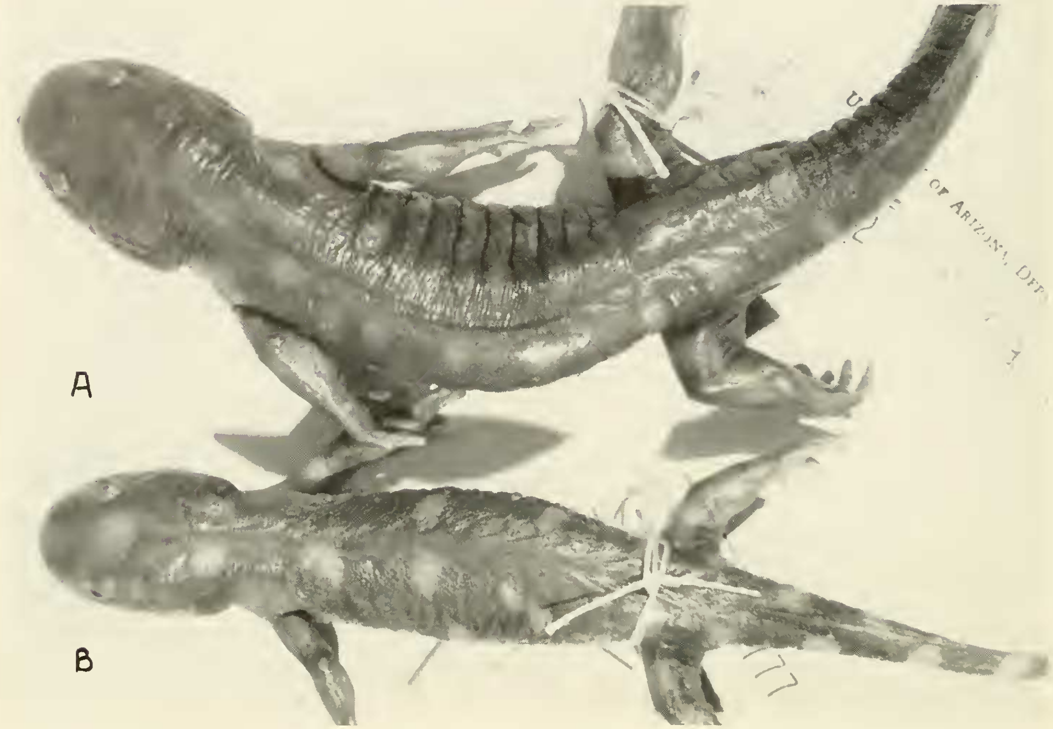

Fig. 9. Adults of *Ambystoma r. rosaceum* Taylor: A, male, UAZ 34642, collected 1 July 1971, 4.6 mi SE Madera on Hwy 16, Chihuahua, S-V length 89.0 mm; B, female, UAS 3477, collected at Yepomera, Chihuahua, 12 June 1972, S-V 75.5 mm.

Milpillas drainage has the round, light spots but with a dark ground color. It is possible that adults from Sonora may be spotted, but with a melanistic ground color, in contrast to the Chihuahua populations and the nearly spotless populations in Durango.

Although additional data from larger series of adults would be helpful, there are at present adequate materials available, both larvae and adults, from Chihuahua and Durango to recognize the following subspecies:

Ambystoma rosaceum rosaceum Taylor
Tarahumara Salamander

Ambystoma rosaceum Taylor, 1939 (1938). Univ. Kansas Sci. Bull. 25: 385–405.

This subspecies is distinguished by bright yellowish spots on an olive green ground color in adults (Figs. 6, 9). Larvae have dark spots and reticulations on a yellowish ground color that may be tinged with a pinkish color and with a lateral, irregular, yellowish stripe in the lateral line area.

It is presently known from the high valleys and mountains of western Chihuahua, mountains of eastern Sonora, and the drainage of the Río Sinaloa in northeastern Sinaloa and southern Chihuahua. The type locality is Mojarachic, Chihuahua. This distribution does not include northern Sonora north and west of the Río Yaqui drainage.

Ambystoma rosaceum nigrum Shannon
Durango Salamander

Ambystoma rosaceum nigrum Shannon, 1951. Proc. U.S. Nat. Mus. 101(3284): 465–484.

This subspecies is distinguished by a dark ground color without the bright yellow spots. Any spots are faint and in most individuals are indistinguishable in adults. Larvae have small, irregular, light spots and reticulations on a dark ground color; the central lateral light stripe may or may not be present (Fig. 10).

It is presently known from the mountains of west central Durango and east central Sinaloa. The type locality is El Salto, Durango.

REMARKS.—At present we do not have all the data that would detail the complete life

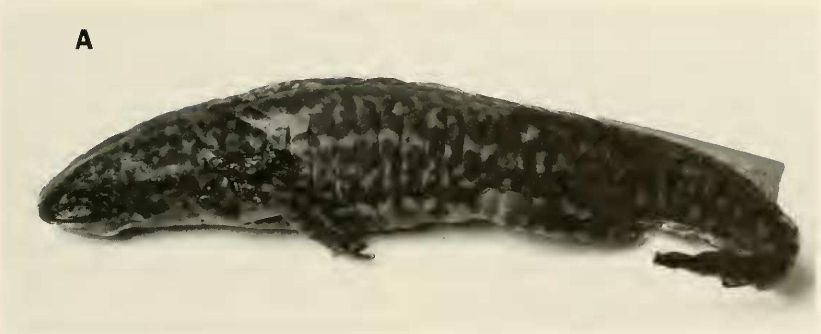

Fig. 10. *Ambystoma r. nigrum* Shannon: A, holotype (larva), USNM 123581, El Salto, Durango, S-V 59.0 mm.

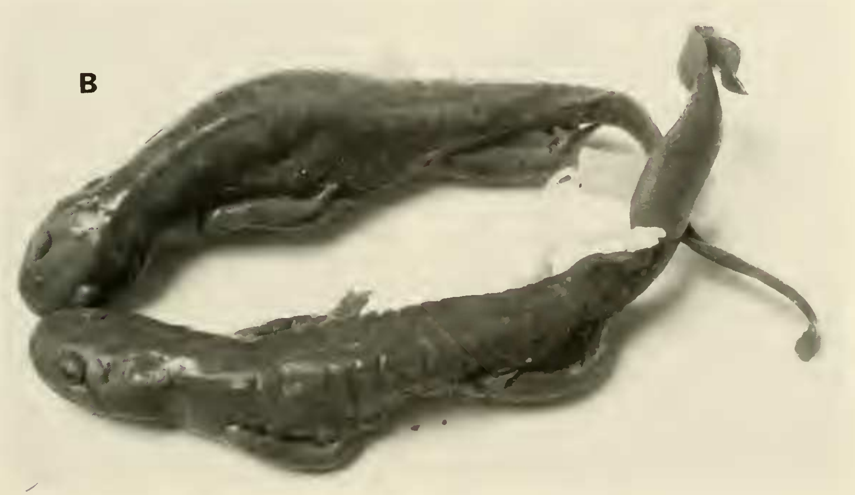

Fig. 10. *Ambystoma r. nigrum* Shannon: B, adults MVZ 57285, S-V 78.0, and 57279, S-V 72.8 collected at Neviero, 4 mi W La Ciudad, Durango.

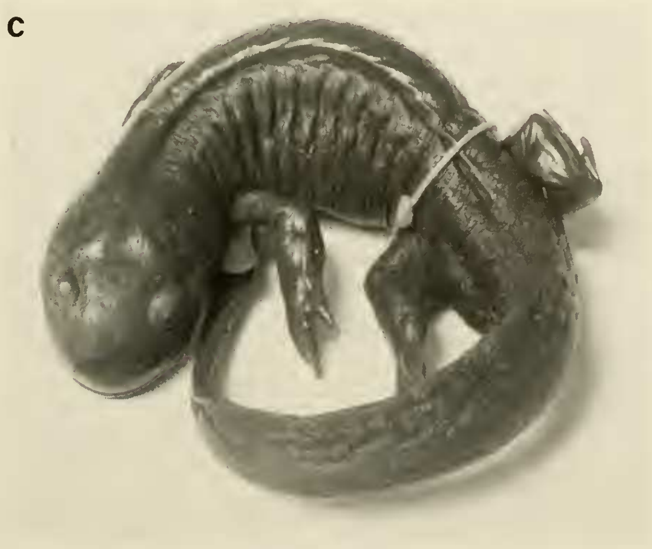

Fig. 10. *Ambystoma r. nigrum* Shannon: C, adult USNM 154571, collected 11 mi W El Salto, Durango.

history of *rosaceum* from egg to mature adult. Such a study presumably would provide details of the size of larvae from hatchling to one transforming, rate of larval growth, age and size of larvae at metamorphosis, and size of breeding adults in the subspecies. Only parts of this sequence are now fully understood. In spite of life history gaps that must yet be filled, data now available do provide a more complete understanding than has been available.

It is obvious that elevation plays an important role in determining the time of egg laying. In Sinaloa (Sierra Surutatas, 48 airline km northeast of Guamuchil, about 3,500 ft) Anderson and Webb (1978) report that eggs were laid in February. We found eggs in Chihuahua in April at about 6,000 ft; Webb and Baker (1984) found them in May on the northeast side of Cerro Mohinora at about 10,000 ft.

Whether eggs are laid in late June or July at the onset of summer rains as suggested by Anderson (1961) has not as yet been observed in Chihuahua populations. Our data suggest that this does not often occur for the following reasons: (a) competition with the larger larvae and life in the increased streamflow, at times in flooding channels, would make survival difficult in many habitats; (b) egg laying that late in the year may not provide enough time for growth and metamorphosis before the water in most habitats is reduced or disappears soon after the close of the rainy season. However, as noted above, other ambystomatid species are known to be stimulated to reproduce late in the season after heavy summer storms, and, though this has as yet not been observed in the *rosaceum* of Chihuahua, it may occur.

The suggestion of Dunn (1940) and Anderson (1961) that larval characteristics are too variable to be useful in systematics may have merit. However, I find that the larvae of *Ambystoma rosaceum* do have a very distinctive color pattern. Both Taylor (1941) and Shannon (1951) used larval characters in establishing and differentiating taxa. Variability should not be a justifiable criterion for eliminating the usefulness of characters that may appear in the sequence of a species' life history.

The external anatomy of *Ambystoma rosaceum* as it appears in the text was prepared before studies dealing with electrophoretic data were reviewed. It is of interest to note that both studies (Shaffer 1983 and Jones *et al.* 1988) arrive at essentially the same conclusions, namely that *rosaceum* is a species distinct from *tigrinum*. Shaffer also concluded that *rosaceum* is a polytypic species with *A. r. rosaceum* in the north (Chihuahua) and *A. r. nigrum* in the south (Durango).

Family Plethodontidae

Genus *Pseudoeurycea* Taylor

Pseudoeurycea belli sierraoccidentalis Lowe, Jones, & Wright

Pine-Oak Plethodon

Pseudoeurycea belli sierraoccidentalis Lowe, Jones, & Wright, 1968, Contributions in Science, Los Angeles County Museum 140: 1–11. Type locality 21 km WSW Yecora, Sonora.

6 km WNW Ocampo (on road to baseball field El Aguila) (Lowe, Van Devender, and Holm, in press).

Four adults were observed on 24 June 1987 by field parties on a trip organized by Paul S. Martin of the University of Arizona. The specimens were emerging from holes in rotted tree roots in the bank of a road cut. Above the road cut is a pine-oak woodland with volcanic boulders and deep leaf litter. The elevation is approximately 1,830 m.

Pseudoeurycea b. sierraoccidentalis is a black salamander with dark red spots on its upper surfaces. Ground color above is a uniform black throughout with little variation between the dorsal and ventral areas. The number of spots for three of the Ocampo animals was 0, 11, and 13, based on field notes and color slides; field photo specimen vouchers are UAZ 47824–25 PSV. The samples include the first spotless individual for the species.

The area of Ocampo, Chihuahua, and the type locality southwest of Yecora, Sonora, are in the headwaters of the Río Mayo. These uplands range above 6,000 ft and are near, if not a part of, the divide between the Río Mayo and Río Yaqui drainage systems. Furthermore, the drainage basins to the east (ca 50 km) include the headwaters of streams flowing north into the Río Yaqui or south into the Río Fuerte (Oteros). This suggests a much larger distribution than is now known for both eastern Sonora and west central Chihuahua.

The type locality and habitat of the type series is in an east-west oriented canyon (barranca) with the upper end extending into an area in or near Chihuahua (Lowe et al. 1968). Thus, the western slopes of the mountains extending from about 5,000 feet in Sonora to at least 6,000–7,000 ft in west central Chihuahua are apparently the present habitat.

Family Pelobatidae

Within this family are genera from a wide distribution that includes representatives from Europe to the South Pacific. In North America only the genus *Scaphiopus* is presently recognized by most authors (Tanner 1939, Zwiefel 1956, Kluge 1966, Estes 1970, Brown 1976). Cope (1889) placed the American spadefoot toads in the family Scaphiopodidae and divided the species into two genera as follows: *Scaphiopus* (*holbrookii* and *couchii*), *Spea* (*hammondii* with three subspecies, *hammondii*, *bombifrons*, and *intermontana*, and *multiplicata* as a species).

The genus *Scaphiopus* has a range from the eastern United States west to the Great Plains (Dakotas south to Texas). The exception is *couchii*, with a range west from southern Texas through the low desert valleys of southern New Mexico, southern Arizona, and into southwestern California between Needles and Vidal Junction (Tinkham 1962). The range also includes northern Mexico from Tamaulipas to Baja California.

The genus *Spea* occurs in the western United States from the Great Plains west to California and south throughout western and southern Mexico. At present four species are listed for this genus (*bombifrons*, *intermontana, hammondii*, and *multiplicatus*) (Brown 1976). There is, however, some question as to whether all are valid as species. This is discussed further below with a brief review of the history of the genus *Spea*. The genus *Spea* was established by Cope (1875) to include the species *stagnalis* from northwestern New Mexico. In this report Cope also proposed the family Scaphiopodidae and included the species *bombifrons* in the genus *Spea*. In 1889 he listed *Spea hammondii* and included *bombifrons* and *intermontana* as *hammondii* subspecies; species status was retained for *multiplicata*.

Cope (1889) gave the following description for the genus *Spea:* "Cranial derm free from cranium; the latter generally with a frontoparietal fontanelle; vomerine teeth present; toes webbed; cuneiform process large." Recognizing that skull modifications had occurred in the genus, he stated: "In one of the subspecies of *S. hammondii* the ossification of the cranium has progressed so far as to close the frontoparietal fontanelle, but not so as to penetrate the cranial integument." Based on our present knowledge of the skull characters in *Spea* we can assume that Cope may have been referring to *intermontana*. Although Cope did not figure the skulls of the species he included in *Spea*, his descriptions strongly indicate that he recognized the uniqueness of the cranial characters, particularly the presence of a frontoparietal fontanelle. The latter is not present in the genus *Scaphiopus*.

Tanner (1939) examined specimens of the subgenus *Scaphiopus* (*holbrookii*, Massachusetts to Florida; *hurterii*, Benton and Lytle, Texas; *couchii*, San Pedro, Baja California; Waco, Fairbanks, and San Antonio, Texas; San Xavier Mission, Arizona) and figured a representative of each species (Fig. 11). The subgenus *Spea* was examined (*bombifrons:* Goodnight, Texas; Lexington, Oklahoma; Elkhart, Kansas; *intermontanus:* Carbon County, Garfield County, Kane County, Juab County, Uintah County, Washington County, Utah; *hammondii:* Cochise County, Arizona; San Jacinto, Riverside County, and San Diego, California; Ojos Negros and Punta Banda, Baja California) and skulls representing each taxon were figured (Fig. 11 reproduced from Tanner 1939, Plate I). He regarded each taxon as a species, in contrast to Cope (1889), who assigned them subspecies status. Schmidt (1953) accepted *bombifrons* and *hammondii* as species but placed *intermontana* as a subspecies of *hammondii*.

The dorsal skull figures of Tanner (1939) clearly illustrate the differences between *Scaphiopus* and *Spea*. It is difficult to assume that such structures should be considered as belonging within a single generic group.

In *Scaphiopus* there is a bony plate extending from the parietal area to the nasal. It covers the interorbital area and is suggestive of a primitive dermal plate. Whether it is a retained primitive dermal bone or one more recently developed, it is a unique, but uniformly simple, covering for the interorbital area. The interorbital skeletal structures in *Spea* are not readily comparable to those of *Scaphiopus*.

Zwiefel (1956) retained *Spea* as a subgenus within *Scaphiopus* and recognized Pelobatidae rather than Scaphiopodidae. His figures of the skulls vary little from those of Tanner (1939), and the relationship of the skin (derm) to the cranium was not considered. The study by Zwiefel (1956) provided an abundance of

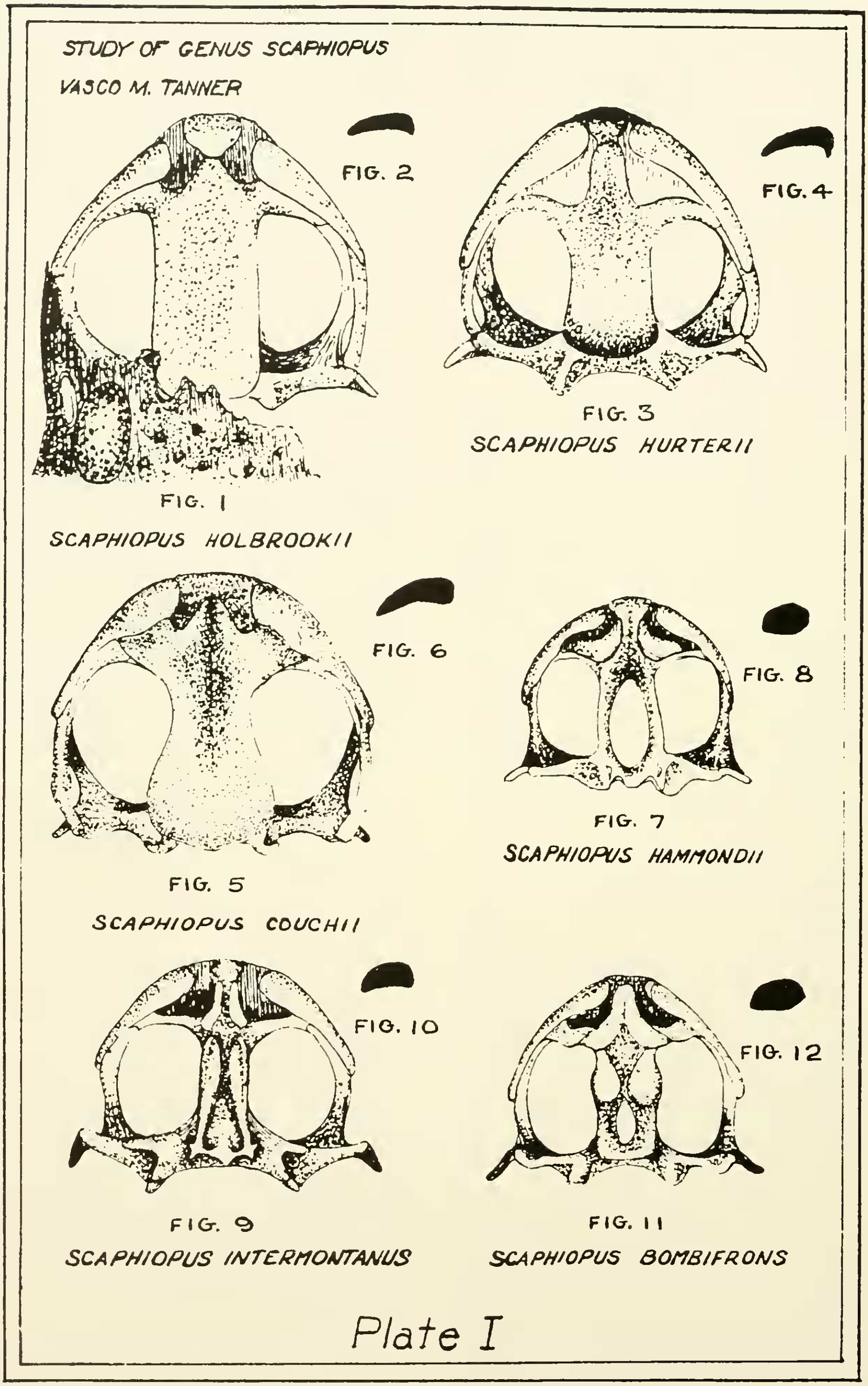
STUDY OF GENUS SCAPHIOPUS
VASCO M. TANNER
FIG. 2
FIG. 4
FIG. 1
SCAPHIOPUS HOLBROOKII
FIG. 3
SCAPHIOPUS HURTERII
FIG. 6
FIG. 8
FIG. 5
SCAPHIOPUS COUCHII
FIG. 7
SCAPHIOPUS HAMMONDII
FIG. 10
FIG. 12
FIG. 9
SCAPHIOPUS INTERMONTANUS
FIG. 11
SCAPHIOPUS BOMBIFRONS
Plate I

Fig. 11. Representative skulls of the genera *Spea* and *Scaphiopus* as prepared by V. M. Tanner (1939).

data; my only concern is that cranial characters were not adequately weighted when generic values were considered.

It is not only skull characters that vary, but also external characters such as the shape of the spade, smaller body size (S-V length), color pattern, and perhaps area of distribution. It appears that *Spea* is a western and southern group, whereas *Scaphiopus* is an eastern genus, in which *couchi* has more recently extended its range west to overlap that of *S. bombifrons* in the Great Plains and *hammondii* in Texas and west to California, including the adjoining border states of Mexico.

Cope (1889) in his key separated *Scaphiopus* from *Spea* on the character of derm involved in the cephalic ossification, which in *Spea* is "distinct from cranium, which is usually only ossified superiorly in two superciliary bars." Restated, the interorbital area is completely ossified in *Scaphiopus* (Fig. 11), whereas in *Spea* only bars of bone and an interorbital fontanelle provide little surface for the derm to be ossified with or to the cranium.

In recent studies other distinguishing characters have been established. Kluge (1966) summarized, in his Table 5, 17 diagnostic characters that distinguish the genus *Spea* from the genus *Scaphiopus*. To retain *Spea* as a subgenus in the genus *Scaphiopus* does not seem to be justified. I am persuaded to recognize *Spea* (as did Cope originally and Tihen [1960]) as a full genus based primarily on the distinct differences in the skull characters. Other characters as indicated by Kluge (1966) do not distract from such a taxonomic change.

Key to the Genera

1. Frontoparietal and nasal bones broad and complete, no interorbital fontanelle; derm ossified and adhering to cranium in the interorbital area; large, S-V length of adults 50+ mm; area between orbits wide, 5–7 mm; spade sickle-shaped and long .... *Scaphiopus* Holbrook

— Frontoparietal area with narrow bars between the orbits, separated by an interorbital fontanelle in *hammondii* and *bombifrons* but thin bone may extend between the interorbitals in *intermontanas;* smaller, S-V of adults 50 mm or less; area between orbits narrow, 4–5 mm; spade not sickle-shaped .... *Spea* Cope

Genus *Scaphiopus* Holbrook

Scaphiopus couchii Baird
Desert Spadefoot

Scaphiopus couchii Baird, 1854, Proc. Acad. Nat. Sci. Philadelphia 7: 62.

Scaphiopus couchii: Wasserman, 1970, Cat. Amer. Amph. and Rept. 85: 1.

Near Cd. Chihuahua, 5 (BYU 10440–44).
Colonia Dublan, 5 (BYU 2142–46i, 2771).
13 mi E Rancho Flores Magon, 4 (BYU 13967–70).
Colonia Juárez, 2 (BYU 14522, 15321).
Southern edge of Cd. Chihuahua, 4 (BYU 10424–27).
2 mi SE Colonia Juárez, 6 (BYU 13446–48, 15452–53, 15586, 15839).
Along road (Hwy 10) 15–30 mi SE Nuevo Casas Grandes, 33 (BYU 14075–14107).
12 mi S Samalayuca, 1 (UAZ 7671).
5 mi SE Galeana, 9 (UAZ 36428–36).
1.6 mi N Galeana, 7 (UAZ 34457–63).
7.1 mi N Cd. Chihuahua, 1 (UAZ 34458).
1.1 mi SW Nuevo Casas Grandes, 1 (UAZ 34456).
1.9 mi S Buenaventura, 2 (UAZ 36427, 36431).
5 mi N Cerro Campana, 17 (MVZ 68776–80, 70608–620).
7 mi N 3 mi E Cerro Campana, 5 (MVZ 70603–7).
Ojo de Laguna 1, (MVZ 12778).
29 mi W Gallego, 7 (MVZ 70600–2, 72776–7, 72779–80).

In the late afternoon of August 1957, Dr. Gerald Robison and I left Ciudad Chihuahua for Colonia Juárez. We intended to do night collecting along the road. Soon after dark a light rain began, and by the time we reached Sueco we were in heavy rain. We saw a few anurans on the road and noted an increase as we drove toward Rancho Magon. The heavy rain continued, and the numbers of anurans on the road increased. By the time we reached Galeana and crossed the Río Santa María, the desert was literally alive with frogs and toads. What had been a few days before a dry, barren landscape was suddenly an expanse teeming with thousands of croaking, hopping creatures that had literally erupted from the earth. Indeed, this was a "show time" not often seen, and, at this time, *Scaphiopus* was a primary participant (Fig. 15).

As we stood on the road and witnessed this assemblage of energetic creatures, we realized that only yesterday they were in a burrow and had perhaps been there for months or even a year awaiting this, their day, to fulfill their biological role in life's program. What a remarkable phenomenon.

Genus *Spea* Cope

A reexamination of the skulls as figured by Tanner (1939) and Zwiefel (1956) and the preparation of others from localities in the range of *S. hammondii* indicate that the latter is a polytypic species with at least three subspecies. The following key, which uses skull characters to separate the species in the genus *Spea*, will serve to identify the species.

Key to the Species of the Genus *Spea*

1. Frontoparietal bones narrow, ridgelike, unmodified and separated by a large fontanelle .... *hammondii*

— Frontoparietal bones modified by a boss or increased bony tissue reducing or nearly eliminating the frontoparietal fontanelle 2

2(1). An enlarged boss near anterior ends of frontoparietals, producing an external swelling between eyes; fontanelle small and posterior to bosses; skin smooth with few tubercles; body length of adults 45–55 mm .... *bombifrons*

— Frontoparietals enlarged ridges but without a distinct boss, fontanelle eliminated or greatly reduced by thin bone between ridges of frontoparietals; skin more rugose; body length of adults 50–60 mm .... *intermontana*

Spea bombifrons Cope
Plains Spadefoot

Scaphiopus bombifrons Cope, 1863, Proc. Acad. Nat. Sci. Philadelphia 15: 53.

Spea hammondii bombifrons: Cope, 1886, J. Acad. Philadelphia 2, 6: 81.

Spea bombifrons: Cope, 1889. U.S. Nat. Mus. Bull. 34: 5–525.

Colonia Dublan, 1 (BYU 415).
Outskirts Cd. Chihuahua, 5 (BYU 10440–44).
13 mi E Rancho Flores Magon, 5 (BYU 13962–66).

Neither Cope (1889), Kellogg (1932), nor Smith and Taylor (1948) listed this species for Mexico. Conant (1975) and Stebbins (1985) listed the range as extending from south central Canada through the plains of central U.S. and into northern Chihuahua. Firschein (1950) and Shannon (1953, 1957) listed specimens for Samalayuca and Cd. Chihuahua.

The existing records place this species in the lower valleys of north and central Chihuahua and not in the higher valleys such as Babicora or Madera just east of the Sierra Madre. In the higher valleys (7,000–9,000 ft) of the mountains only *multiplicata* was found.

Spea hammondii Baird
Western Spadefoot

Scaphiopus hammondii Baird, 1857 (1859). Explorations and Surveys for a Railroad Route from the Mississippi River to the Pacific Ocean 10, Pt. 4, No. 4: 12.

Spea hammondii: Cope, 1889. U.S. Nat. Mus. Bull. 34: 5–525.

There has been much uncertainty and doubt concerning the proper systematics for populations inhabiting a wide area in southwestern United States and Mexico. Brown (1976) included all populations of *Scaphiopus hammondii* that were east and south of California in a single species, *Scaphiopus multiplicatus*. His careful research of two populations (southern California and southeastern Arizona) added greatly to our understanding of life-history variables in these two segments of the *S. hammondii* complex. There are, however, two basic areas that are not yet fully researched. Apparently, there is little or no difference in the skeletal characters, and the two populations are interfertile with no apparent postmating isolation (Brown 1976: 2).

If we accept the skull characters as being the basic characteristic of the species in the genus *Spea* (as has been done for *bombifrons* and *intermontana*), then the open, unmodified frontoparietal fontanelle (Fig. 11 from Tanner 1939, his Fig. 7) is the basic character for the species *S. hammondii*. It is obvious that isolation and habitat modification were brought about by the desiccation after the Pleistocene period (Morafka 1988). External characteristics of the habitat were modified, of course, and then these variations directly affected the life-history characters of the populations in a wide area originally occupied by this species.

It seems reasonable to believe that in this widespread *hammondii* complex of populations there is a series of geographical subspecies that are related through cranial characters but show subspecific variations in external characters and life-history variables. Those who have examined the skulls (Tanner 1939, Zweifel 1956) have found no significant differences. The various populations show variation in the external anatomy (size S-V, skin texture, nature of mating calls, and adaptation to changes in the aquatic environment; Bragg 1945, Brown 1976).

The dorsal view of skulls from numerous localities indicates rather uniform skull characters for populations ranging over a wide area in southwestern United States and northwestern Mexico (Figs. 11, 12, 14).

The following key is an attempt to identify the subspecies that may presently be recognized. It should be noted that far more research dealing with all internal and external

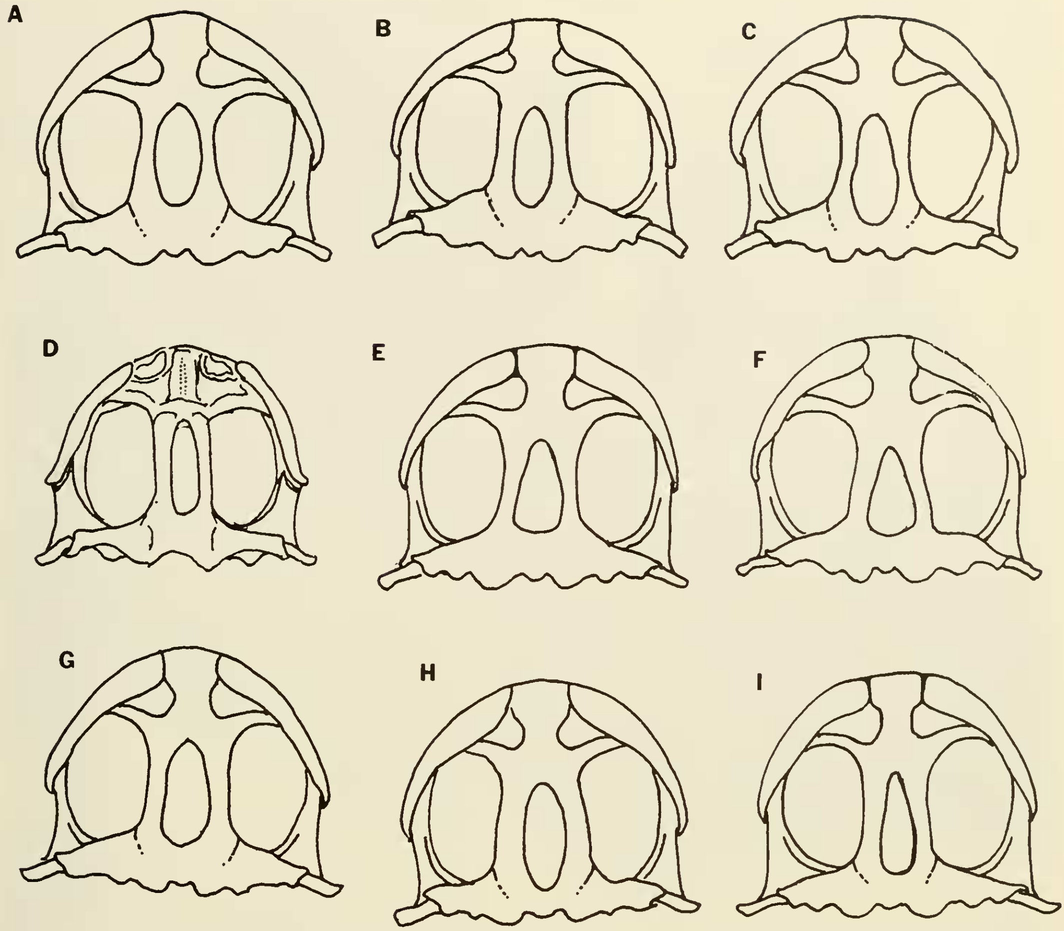

Fig. 12. Dorsal view of the skulls of *Spea hammondii* representing the following populations: A, Brewster County, Texas (BYU 2767); B, 0.5 mi W Kirtland, San Juan County, New Mexico (UNM 47614); C, Chiricahua Mt., Cochise County, Arizona (BYU 8932); D, Navajoland, Many Farms, Apache County, Arizona (LACM 127298); E, 11.1 mi NW Yepomera, Chihuahua (UAZ 34818, see Fig. 14A); F, 3.8 mi SE Yepomera, Chihuahua (UAZ 34814, see Fig. 14B); G, 18.8 mi N Cd. Durango (BYU 15526); H, El Rosario, Baja California, (BYU 34551); I, San Diego, California (BYU 2141). Note: These drawings are designed to show the size, shape, and position of the frontoparietal fontanelle to the dorsal skull structure in the species *Spea hammondii* Baird. These figures were prepared by Kaye H. Thorne.

characters must be done before a complete understanding of *S. hammondii* is obtained, particularly for the Mexican populations.

Key to the Subspecies of *Spea hammondii* Baird

1. Skin of upper parts unusually warty, dorsal tubercles large and numerous; heel usually reaching to tympanum (Fig. 13-A) ..... *h. multiplicata*

— Skin smooth or with fewer low tubercles; often a dorsal pattern of lighter stripes or spots; heel usually not reaching tympanum (Fig. 13-B) 2

2(1). Adults large, 50–55 mm S-V; interorbital fontanelle large and usually extending medially beyond the posterior margins of the orbits .... *h. hammondii*

— Adults smaller, 45–50 mm S-V; interorbital fontanelle large, but not extending posterior to the orbits .... *hammondii stagnalis*

REMARKS.—Differences in mating calls and adaptation to seasonal precipitation (March in California and July in Arizona) cannot be used as key characters for preserved museum specimens. Such life-history characters are important in demonstrating differences brought about by isolation and changes in the environment that have resulted from desiccation in an area of a formerly more widespread species. The data presented by Brown (1976) are important in that the biological evolutionary

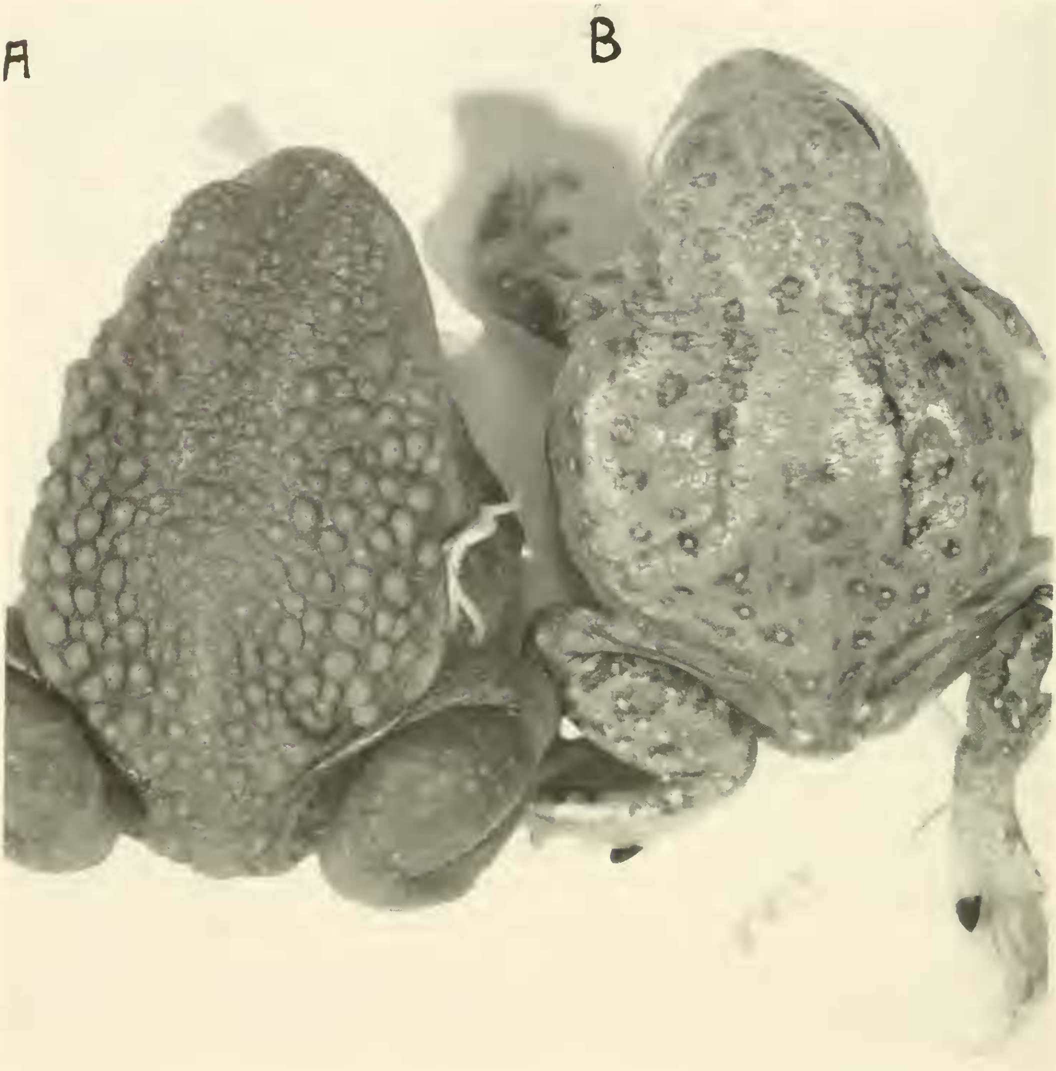

Fig. 13. *Scaphiopus hammondii:* A, *Spea h. multiplicatus,* UAZ 34818, 11.1 mi NW Yepomera, Chihuahua, on Road 16, ca 7,000 ft, in pine forest; B, *Spea h. hammondii,* UAZ 34814, 3.8 mi SE Yepomera, Chihuahua, on Road 16, ca 6,200 ft, in grassland; a distance of 15 mi and an elevation differential of 800 ft provide an environmental change that ecologically separates these populations.

divergence is established and provides population data that cannot be ascertained by a study of the external or internal anatomy. There are, however, few divergences in the crania of these widespread *hammondii* populations. They are apparently interfertile, although further research is needed for the extensive Mexican populations.

In view of the similarity in cranial characters and the fact that the widespread *hammondii* populations are interfertile, I am persuaded to consider *hammondii* a polytypic species, consisting of at least three subspecies: *h. hammondii* in California and Baja California; *h. stagnalis* in Arizona, New Mexico, southwestern Texas, and the valleys on each side of the Sierra Madre in Chihuahua, Durango, and Sonora. In the higher mountain valleys extending from western Chihuahua south into central and southern Mexico is *h. multiplicata.*

Spea hammondii stagnalis Cope

Scaphiopus hammondii Baird, 1859, Expl. Surv., R.R.

Miss. Pacific, 10, Pt. 4, No. 412. Fort Reading, California (part).

Spea stagnalis Cope, 1875, *in* Yarrow, U.S. Geol. Surv. W. 100th Meridian 5: 525. Northwestern New Mexico.

Scaphiopus hammondi hammondi Schmidt, 1953, Checklist North American Amphibians and Reptiles. Amer. Soc. Ichth. and Herpet. 6th ed., p. 59 (part).

Scaphiopus multiplicatus: Brown 1976. Los Angeles County Nat. Hist. Mus. 286: 1–15 (part).

12 mi SE Babicora (approx halfway between Babicora and Gomez Farias), 14 (BYU 14453–67, 15571–80).

10 mi W San Francisco del Oro, 1 (BYU 15677).

Chuhuichupa, 1 (BYU 15481).

0.3–18.3 mi SE Madera (along Hwy 16), 15 (UAZ 34649–51, 34656–61, 34663–64, 34666–68, 35040).

Yepomera 14 (UAZ 34652–55, 34804–13).

3.8 mi SE Yepomera, 1 (UAZ 34814).

6.2–6.6 mi NW Yepomera, 4 (UAZ 34815–17, 35041).

11.1 mi NW Yepomera, 1 (UAZ 34818).

2 mi S Santa Clara, 24 (MVZ 70622–70645).

1 mi S 1/2 mi E Santa Clara, 1 (MVZ 72790).

5 mi N Cerro Campana, 1 (MVZ 72791).

Ojo de Laguna, 1 (MVZ 72792).

Arroyo Mesteno (Sierra del Nido), 3 (MVZ 72787–9).

Specimens collected in the higher valleys (Babicora, Madera, and Yepomera) have fewer and lower tubercles and thus a smoother skin (Fig. 13). In other characteristics they do not vary greatly from specimens taken in the mountains. The relationships between those populations previously referred to as *hammondii* and *multiplicatus* show a close relationship but do show differences that suggest, at least in Chihuahua populations, that distinctions between mountain populations (7,000–9,000 ft) and those at lower elevations can be made on the basis of skin texture, if not on other characteristics (Fig. 13).

REMARKS.—In 1875 Cope described as a new species *Spea stagnalis*. The type locality is northwestern New Mexico on the Eocene Plateau. This population has been considered a part of the subspecies occurring in the lower southern valleys extending from southwest Texas west through southern New Mexico, Arizona, and the adjoining Mexican states of Chihuahua and Sonora.

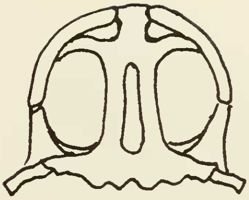

Fig. 14. *Spea stagnalis* Cope: cotype USNM 25335, northwest New Mexico, dorsal view of skull.

The question arises as to whether *S. stagnalis* belongs to the southern populations or if indeed those populations in northern New Mexico belong to the northern species *S. intermontana* that have been listed as occurring in the Upper Colorado Basin and the Great Basin. An examination of the cotype USNM 25335 (that was figured by Cope 1875 in Yarrow, Plate 25, Figs. 6–8) determined that the cotypes had the same cranial characters as other populations in the *Spea hammondii* complex (Fig. 14). By recognizing the California populations as *Spea h. hammondii*, the eastern populations (Arizona, New Mexico, Texas, and those in the adjoining states of Mexico) must now be recognized as *Spea h. stagnalis* Cope.

The distribution of the species of *Spea* is uncertain in the headwaters of the Río Grande and the Upper Colorado Basin. It appears that *bombifrons* extends well into the Upper Basin. A further study including populations in the adjoining areas north of *h. stagnalis* may provide a clarification of distribution as well as any further subspeciation that might have occurred in this rugged area consisting of mountains and plateaus dissected by deep canyons and isolated by deserts. To complete such a study is beyond the scope of this report. This report on the species *S. hammondii* is preliminary not only to an extensive study of this widespread species but also to a study of the entire genus *Spea*.

Spea hammondii multiplicata Cope
Mexican Spadefoot

Scaphiopus multiplicatus Cope, 1863, Proc. Acad. Nat. Sci. Philadelphia 15: 52.

Scaphiopus hammondii multiplicatus: Kellogg, 1932, U.S. Nat. Mus. Bull. 160: 22–24.

Scaphiopus multiplicatus: Smith and Taylor, 1948, U.S. Nat. Mus. Bull. 194: 36.

Chihuichupa, 35 (BYU 14388–403, 15391–409).

Cerocuhui, 2 (BYU 15502–3).

2 mi S Creel (along road to La Bufa), 6 (BYU 15598, 17801; UAZ 31220–23).

3.2 mi E Agostadero de Aguire, 1 (UAZ 46815).

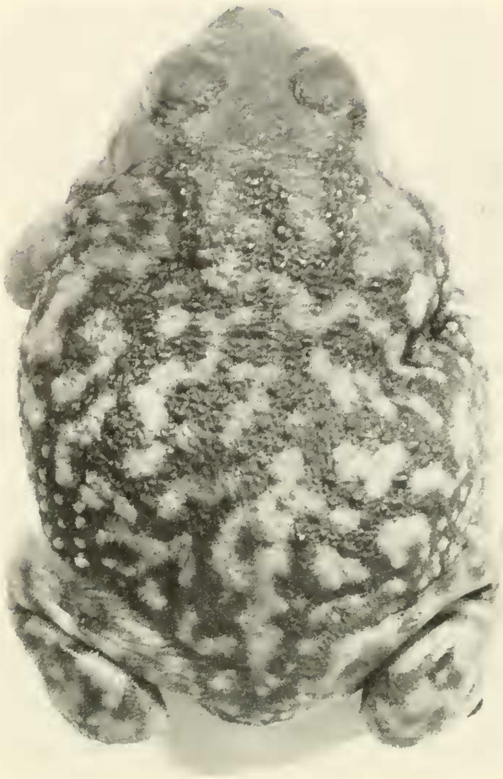

Fig. 15. *Scaphiopus couchi:* BYU 15839, collected 2 mi SE Colonia Juárez, 30 July 1958, S-V 69.5.

The distribution of *multiplicata* was considered by Smith and Taylor (1948) to be on "the plateau of central Mexico from Durango and Zacatecas southward." Conant (1975) did not recognize *multiplicata* and extended the range of *hammondii* to occupy not only southwestern United States but also the area previously designated for *multiplicata* by Smith and Taylor (1948). Stebbins (1985) apparently accepted the conclusions of Brown (1976) and replaced *hammondii* with *multiplicata* for essentially the same area indicated by Conant.

The relationship of these two taxa is close and thus warrants additional study. Until additional investigation establishes the degree of relationship, I will not attempt to further define the taxonomic status of the Mexican populations of *S. h. multiplicata*.

Family Bufonidae

Genus *Bufo* Laurenti

The state of Chihuahua contains nine species of *Bufo*. Some have entered the state from the north and east as a part of the desert habitat (*cognatus*, *debilis*, *punctatus*, *speciosus*, and *woodhousei*). Others occur in the mountains of the south (*simus*), the northwest (*microscaphus*), and the west (*marinus* and *mazatlanensis*).

Thus, this large state, with its eastern deserts, central foothills and low ranges, and western mountains and deep western canyons, provides a variety of habitats singular to Chihuahua. Within this diverse area is perhaps the largest assemblage of bufonid toads to be found in Mexico.

In this report no attempt is made to cite all the synonyms for these bufonid species. These can be found in the reports of Cope (1889), Kellogg (1932), or Smith and Taylor (1948).

Bufo cognatus Say
Great Plains Toad

Bufo cognatus Say, 1823, Long's Exped. Rocky Mts., Vol. 2: 190. Footnote: Arkansas River, Prowers County, Colorado.

Bufo dipternus Cope, 1879, Amer. Nat. 13: 437. Fort Benton, Choteau County, Montana.

Southern outskirts of Cd. Chihuahua, 4 (BYU 10457–60).

13 mi E Rancho Flores Magon, 7 (BYU 13955–61).

Approx 15 mi SE Nuevo Casas Grandes, 2 (BYU 14109, 15838).

25 mi SE Las Varas (Mennonite Village), 3 (BYU 15433–35).

Valley Road approx halfway between Babicora and Gómez Farías, 9 (BYU 15564–67, 15757–61).

Hidalgo del Parral, 6 adults and 21 untagged small ones (BYU 15558–63).

13.2 mi S Nuevo Casas Grandes, 2 (UAZ 34444–5).

4.9 mi N El Arco (36.5 mi S El Sueco), 2 (UAZ 34386, 34397).

2.0 mi N Villa Ahumada, 5 (UAZ 36281–2).

4.7 mi S Galeana, 2 (UAZ 36281–2).

1.0 mi NW Temosachic, 1 (UAZ 34832).

28 mi N Cd. Chihuahua, 1 (UAZ 34206).

3.7 mi S Buenaventura, 1 (UAZ 36280).

28 mi S Cd. Juaŕez, 1 (UAZ 34449).

5 mi N Cerro Campana, 6 (MVZ 70678–83).

Ojo de Laguna (25 mi S Gallego), 11 (MVZ 72764–80, 72784–7).

2 mi S Santa Clara, 4 (MVZ 70676–7, 72762–3).

Smith and Taylor (1948) list the following localities: Río Santa María near Progreso, near Villa Ahumada, 3 mi E Carmen and Colonia Juárez.

The above records indicate that the distribution of this species is in central Chihuahua primarily between the western mountains and eastern desert. Smith, Williams, and Moll (1963) report two specimens from Cuchillo Parada taken after a heavy rain. This locality is near the Río Conchos in northeastern Chihuahua.

Bufo debilis insidior (Girard)
Western Green Toad

Bufo debilis Girard, 1854, Proc. Acad. Nat. Sci. Philadelphia 7: 87.

Bufo debilis insidior: Smith, 1950, Misc. Publ. Univ. Kansas, Mus. Nat. Hist. 1: 75.

13 mi E Rancho Flores Magon, 7 (BYU 13948–54).

15–30 mi SE Nuevo Casas Grandes along Hwy 10, 6 (BYU 14108, 14110–14).

27.6 mi N Villa Ahumada (Hwy 45), 3 (UTEP 2059, UAZ 34830–1).

8.4 mi N Villa Ahumada, 1 (UAZ 11471).

3.9 mi N Villa Ahumada, 1 (UAZ 34472).

31.0 mi N Villa Ahumada, 1 (UAZ 34473).

2.0 mi N Villa Ahumada, 2 (UAZ 34828–9).

11.8 mi N El Arco Iris (31.3 mi S Sueco), 1 (UAZ 34471).

5 mi N Cerro Campana, 1 (MVZ 70647).

7 mi N 3 mi E Cerro Campana, 9 (MVZ 70648–56).

Ojo de Laguna, 10 (MVZ 72752–61).

During and immediately after heavy summer rains, this species may appear in great numbers along roads in Durango and Chihuahua. We collected 34 specimens 18.8 mi north of Durango City after a heavy evening rain on 24 July 1958 and could have collected a bushel from one roadside pond.

This species was unusually abundant, and we found ourselves in a community of toads and frogs the likes of which I had not seen before, but which I experienced again on the night of 28 July on our trip from Ciudad Chihuahua to Colonia Juárez. This species was seen along the road (Hwy. 45 and 10), at times in great numbers, but was particularly numerous in Chihuahua from Buenaventura to near Nuevo Casas Grandes.

I have followed Smith (1950), Schmidt (1953), and Conant (1975) in placing *insidior* as a subspecies of *debilis*. Determining whether there are two species, one east (*debilis*) and one west (*insidior*) as originally described by Girard (1854) and accepted by Smith and Taylor (1948), or whether this widespread group is indeed a series of subspecies must await an intensive study of the entire assemblage of available specimens. At present there is an abundance of material to be studied. This includes specimens from Zacatecas north through Durango, Chihuahua, Sonora, and into Arizona and New Mexico. The eastern segment extends from Tamaulipas north into Texas. A careful comparison of these populations may lead to an understanding of this interesting group of toads.

Kellogg (1932) lists two specimens (USNM 2622) from Chihuahua and notes the designation in the museum catalogue as the cotypes of *Bufo insidior*. No specific locality is listed in the catalogue, only Chihuahua, Mexico.

Bufo marinus Linnaeus
Giant Toad

Rana marina Linnaeus, 1758, Systema Naturae, Ed. 10, 1: 211.

Bufo horribilis Wiegmann, 1833, Isis von Oken 26: 654–655.

Bufo marinus Kellogg, 1932, U.S. Nat. Mus. Bull. 160-31-21, pp. 53–57, Fig. 11. Easteal 1986, p. 395.1–.4.

Urique, 10 (BYU 14355–64).

We arrived at Urique on the evening of 14 July and were soon greeted by large toads in the streets and along the nearby river. A moderate rain shower had occurred in the afternoon. Thus, it was warm and humid and we were soon aware that on such evenings toads and fruit bats were active. In the dim light of a nearby dwelling and from a radius of a few yards, 12 large toads were counted in less than one minute. As I moved about, their numbers did not seem to diminish. The next morning the toads were gone and were replaced by curious youngsters. Thus began three days in the old mining town of Urique.

Bufo punctatus Baird & Girard
Red-Spotted Toad

Bufo punctatus Baird & Girard, 1852, Proc. Acad. Nat. Sci. Philadelphia 6: 173.

36 mi S Ciudad Juárez, 1 (BYU 15207).

Ciudad Chihuahua, 1 (BYU 14252).

Cerocahui, 4 (BYU 14342, 14367, 14576–7).

Cuitaco, 3 (BYU 14527–29).

Urique, 1 (BYU 14341).

Crossing at Los Chales, 5 (BYU 15704–8).

35 mi SW Nuevo Casas Grandes, 1 (BYU 15454).

Colonia Juárez, 3 (BYU 17045–47).

Sierra del Nido Complex, 4.7 mi (by road) W Encinillas, 1 (UTEP 546).

7.5 mi (by road) ESE Buenaventura, 1 (UTEP 547).

NW La Junta at junction of road to Ciudad Guerrero, 1 (UTEP 558).

6.5 mi (by road) NE Ciudad Guerrero, 1 (UTEP 559).

Cd. Chihuahua, 1 (UAZ 11296).

Coyame, 5 (UAZ 34965–69).

8.3 mi W Coyame (hwy to Aldama), 1 (UAZ 34971).

11.2 mi W Coyame, 7 (UAZ 34972–78).

20.6 mi W Coyame, 1 (UAZ 34979).

15.0 mi S Nuevo Casas Grandes, 1 (UAZ 34470).

6.3 mi S Buenaventura, 4 (UAZ 36276–79).

6.5 mi NW Yepomera, 1 (UAZ 34826).

4.3 mi NW Yepomera, 1 (UAZ 34827).

2.7 mi S Milpillas (road to San Antonio, Sonora), 1 (UAZ).

24.6 mi S Ahumada, 7 (MVZ 52167–73).

Hidalgo del Parral, 1 (MVZ 58736).

5 mi N Cerro Campana, 18 (MVZ 68764–75, 70662–67).

2 mi S Santa Clara, 5 (MVZ 70657–61).

This species is seemingly widespread in Chihuahua, based on the above collection records. It should be noted here that much time was spent during the dry season when this species may not have been abroad. Our records place them in the desert valleys and foothill area usually between 5,000 and 7,000 ft in suitable habitats in central and western Chihuahua. We did not find them at the higher elevations.

Smith et al. (1963) report two specimens from eastern Chihuahua, one from near Beneficio and one from near Alamo. Both were near the Río Conchos.

Bufo speciosus Girard
Texas Toad

Bufo compactilis Wiegmann, 1833, Isis, p. 661 (part).

Bufo speciosus Girard, 1854, Proc. Acad. Nat. Sci. Philadelphia 7: 85–87.

Bufo compactilis speciosus: Smith, 1947, Herpetologica 4(1): 7–13.

Bufo speciosus: Conant, 1975, Field Guide: p. 313, map 268; Stebbins 1985, Field Guide: pp. 74–75, map 36.

1.7 mi NW Matachic, 1 (UAZ 34387).

2.5 mi NW Matachic, 1 (UAZ 34823).

2.6 mi SE Matachic, 2 (UAZ 34388–89).

The record for Guadalupe y Calvo may be in question. Webb and Baker (1984) collected *B. microscaphus* in this general area, and it is suspected that the Kellogg (1932) citation (USNM 47244) may be a confusion of *speciosus* (*compactilis*) with *microscaphus*. The latter is commonly found in the mountains, whereas *speciosus* is in the grassland plain habitat at lower elevations. Valleys in the general area of Matachic, Yepomera, and between Babicora and Gómez Farías are suitable habitats. Kellogg (1932) also listed *Bufo compactilis* for Colonia García, and Meadow Valley, where *Bufo microscaphus* occurs.

Stebbins (1985) did not recognize the records of Van Devender and Lowe (1977) for Matachic and confined the distribution of *speciosus* to a narrow edge of eastern Chihuahua. Conant (1975) extended the range into central Chihuahua, approaching the area of Matachic, but gave no locality records.

Originally, the valley between Gómez Farías and Babicora, to the northwest, was a grassy plain that served as a large cattle ranch. This may have been the case for other nearby valleys such as Matachic and Madera. In their original state these valleys seemingly served as havens for many species since they were at elevations above the hot, dry deserts and yet not in the mountains. On examination of the species listed in the report of Van Devender and Lowe (1977) one is impressed with the importance of this general habitat as a refugium as the deserts slowly claimed previous habitable areas after the last pluvial period.

Bufo microscaphus mexicanus Brocchi
Western Madre Toad

Bufo mexicanus Brocchi, 1879, Bull. Soc. Philom., Ser. 1, 3: 23–24.

Bufo microscaphus Cope, 1867, Proc. Acad. Nat. Sci. Philadelphia 18: 301.

Bufo woodhousii microscaphus Shannon, 1949, Bull Chicago Acad. Sci. 8(15): 301–12.

Bufo microscaphus mexicanus Webb, 1972, Herpetologica 28(1): 1–6.

Near Colonia Juárez, 2 (BYU 13516–17).

Chuhuichupa environs, 16 (BYU 13974, 14129–31, 14234–37, 14239–42, 15390, 15485).

Hope Valley at junction of Río Juárez, 1 (BYU 14238).

Mouth of Tinaja Canyon near Colonia Juárez, 1 (BYU 15581).

12 mi SE Babicora, 1 (BYU 15763).

Black Canyon, approx 8 mi W Chuhuichupa, 3 (BYU 14253–55).

26 mi W San Juanito, on road to Maguarichic, 1 (BYU 16957).

11 mi W San Juanito, 1 (BYU 16878).

San Juanito, 2 (BYU 15768, 17036).

2 mi SE Creel, 5 (BYU 15638–40, UAZ 37365–6).

25.5 mi S Creel, 2 (BYU 17048, 17050).
Cerocahui, 7 (BYU 14543–48, 14578).
Cuiteco, 3 (BYU 14294, 15507, 15781).
1 mi W La Laja, 1 (BYU 15872).
Maguarichic, 2 (BYU 16936–37).
Along Río Urique near Carmen Bridge, 9 (BYU 22703–22711).
Río San Miguel at San Juan de Dios, 1 (BYU 22623).
Río Gavilan, 1 mi SE Gavilanisto, 1 (UAZ 8960).
Basaseachic Parque Nacional, 2 (UAZ 47005, 47240).
Yaguirachic (130 mi W Cd. Chihuahua), 15 (MVZ 65982–93, 65996–8).

This is a widespread species in the western mountains of Chihuahua. It descends into the mouths of some canyons but has not been found in the desert valleys. The distribution of *mexicanus*, at least in Chihuahua, is apparently restricted to elevations at or above 6,000 ft. This is in contrast to *microscaphus*, which is found along desert streams in the southwestern United States (northwestern Arizona, and adjoining California, Nevada, and Utah) at much lower elevations. At none of the collecting localities were large numbers seen. The nine specimens taken near the Carmen Bridge were adults and juveniles.

Since *microscaphus* Cope (1867) and *mexicanus* Brocchii (1879) were described, various taxa have been used to include representatives of this species. Thus, for the past hundred years, populations of this species have been assigned as a part of *Bufo compactilis*, *Bufo columbiensis*, *Bufo woodhousei*, or as subspecies within one of the above or with a reference to such subspecies as *californicus* or *speciosus*. The close resemblance of *microscaphus* to other *Bufo* species in the southwestern United States and northwestern Mexico contributed to the taxonomic confusion.

Shannon (1949) recognized the distinctness of *microscaphus*, separated it from *compactilis*, but retained it as a subspecies of *Bufo woodhousei*. The detailed study by Webb (1972) has presumably extricated *microscaphus* from a confused and uncertain past and described it as a unique species, sharing similar characters with other sympatric species but with morphological characteristics such as uniqueness of foot tubercles, size, shape, and position of parotoid gland, warts on back low, rounded and mostly smooth, and color pattern of light brownish spots on the body and without spotting on the venter.

The nomenclatural review and description of *microscaphus* and its subspecies *mexicanus* by Webb (1972) has not only clarified the position of *microscaphus* and its subspecies but has also improved our understanding of its distribution in Mexico.

Bufo woodhousei australis Shannon & Lowe
Southwestern Woodhouse Toad

Bufo woodhousei Girard, 1854, Proc. Acad. Nat. Sci. Philadelphia 7: 86.

Bufo frontosus Cope, 1866, Proc. Acad. Nat. Sci. Philadelphia 18: 301.

Bufo woodhousei woodhousei Smith, 1934, Amer. Midl. Nat. 15: 449–57.

Bufo woodhousei australis Shannon & Lowe, 1955, Herpetologica 11: 185.

García, 1 (BYU 160).
Colonia Juárez, 2 (BYU 13581–2).
Colonia Dublan, 2 (BYU 13971, 15455).
Río Bavispe, below Tres Ríos, 2 (BYU 13458 and 13497).
Nuevo Casas Grandes, 1 (BYU 15455).
Yepomera, 1 (UTEP 2052).
2 mi N Yepomera, 1 (UAZ 34442).
6.3 mi NW Cd. Guerrero, 1 (UAZ 34443).
Yepomera, 12 (UAZ 34372–79, 34340–1, 34381, 34824).
6.9 mi NW Yepomera, 1 (UAZ 34645).
5 km N Yepomera, 1 (UAZ 36285).
2 mi SE Matachic, 2 (UAZ 12742, 34384–5).
Matachic, 1 (UAZ 34342).
4.5 mi SE Temosachic, 1 (UAZ 34382).
50 mi SE Galeana (Hwy 10), 1 (UAZ 34669).
2 mi N Janos, 3 (UAZ 34956, 36283–4).
6.5 mi N Nuevo Casas Grandes, (Hwy 10) 1 (UAZ 36286).
12.7 mi NW Gran Morales, 4 (MVZ 52179–82).
Río San Pedro, Meoqui, 2 (MVZ 52183–4).
Minaca (Río Papigochic), 5 (MVZ 52184, 58727–30).
Ojo de Laguna, 1 (MVZ 75873).
2 mi S Santa Clara, 8 (MVZ 70668–72, 70674–5, 72751).

The above records place this species in or near the Sierra Madre and north of the Río Papigochic. Conant 1974 (1977) extends its range southeast along the Río Grande and south along the Río Couchos into south central Chihuahua. *Bufo woodhousei* has been collected in streamside habitats and in the higher valleys near the western mountains where permanent streams are fed by springs. We did not find them in the mountains of western Chihuahua.

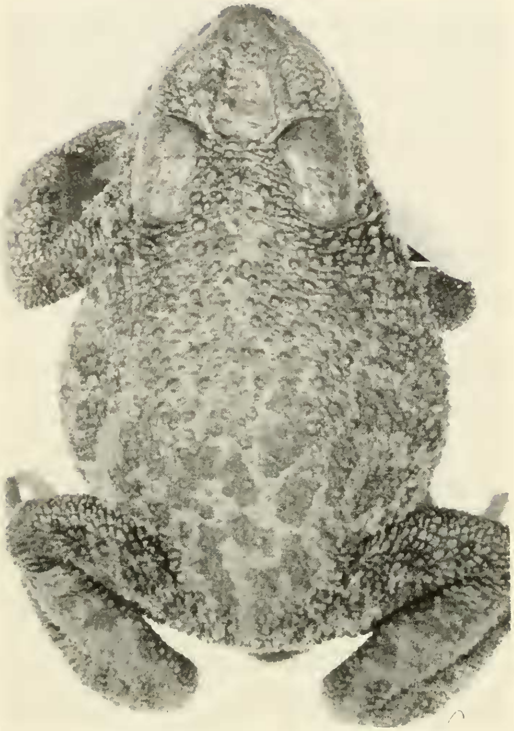

Fig. 16 *Bufo simus* Schmidt: BYU 17134, collected 25.5 mi S Creel, Chihuahua, 18 July 1960.

Bufo simus Schmidt

Bufo simus Schmidt, 1858, Denkschr, Akad. Wiss. Wien, math-nat. Class. 14: 254–55).

Bufo intermedius Gunther, 1858 (1859), Catalogue of the Batrachia Salientia in the collection of the British Museum, p. 140, pl. 9, Fig. FF.

Cerocahui, 1 (BYU 14542).

25.5 mi S Creel, 5 (BYU 17049, 17134–37).

SW Chihuahua, Río San Miguel, 1 (BYU 39373).

We found this species only in the Río El Fuerte basin and near streams during the rainy season. Smith and Taylor (1948) listed this species for Chihuahua but gave no localities. Webb and Baker (1984) did not report it for the Cerro Mohinora region during the dry season of late May (21–30). Its occurrence in adjoining Durango and Sinaloa suggests a distribution in the mountains of southern Chihuahua, at least southwest and southeast of Creel (Fig. 16).

Bufo mazatlanensis Taylor
Mazatlan Toad

Bufo mazatlanensis Taylor, 1939 (1940), Univ. Kansas Sci. Bull. 26: 492–494, p. 53, Fig. 1.

Urique, 14 (BYU 14343–54, 15556–7).

3 mi NNW Moris on Río Santa María (ca 800 m), Río Mayo drainage, 1 (UAZ).

This species was abundant along the Río Urique and in the streets of Urique on the evening of 14 July 1958. We were at Urique for three nights and two and one-half days. Between rain showers we collected specimens and tried to sample as many habitats as possible. It was at Urique that we first witnessed the emergence of multitudes of *Bufo* at dusk each evening.

While we were at Urique, the weather was hot and humid. Mornings were clear, but light rain showers occurred in the afternoons, contributing to the humidity and providing a proper environment for the toads each evening.

Family Leptodactylidae

Genus *Eleutherodactylus* Dumeril & Bibron
Eleutherodactylus tarahumaraensis Taylor
Tarahumara Barking Frog

Eleutherodactylus tarahumaraensis Taylor, 1940, Copeia 1940: 250–253.

Eleutherodactylus augusti: Bogert and Oliver, 1945, Bull. Amer. Mus. Nat. Hist. 83: 405–6.

Eleutherodactylus tarahumaraensis: Zweifel, 1956, Amer. Mus. Novitates. No. 1813: 28–33.

2 mi E Cerocahui, 1 (BYU 14385).

Maguarichic, 1 (BYU 16926).

6 km WNW Ocampo, 3 (UAZ 24741–2 and 47237).

The type (EHT-HMS 13008) collected at Mojarachic by Irving Knobloch.

7 mi SW El Vergel (Lagunita), 1 (MVZ 58797).

Yaguirachic, 2 (MVZ 65974–5).

The specimen taken at Cerocahui was under a rock in a moist area. It was spotted green on the back, had larger feet and eyes than other frogs of similar size, and had a snout-vent length of 23.5 mm. The specimen from Maguarichic was taken two years later (1960) at the same time, 13 July, and is 30 mm in S-V (Fig. 17). Both specimens are juvenile, and in neither locality could we find other specimens. Both were collected at a moist hillside habitat with permanent water at least 1/2 mile away. It should be noted that during the rainy season seeps occur in hillside depressions.

The figure by Zweifel (1956) of a specimen from southern Chihuahua has essentially the same color pattern as the juveniles listed above. Spotting is more diffused or less patterned than appears to be the case for other

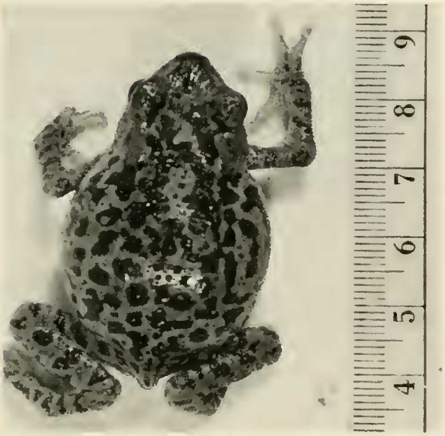

Fig. 17. *Eleutherodactylus tarahumaraensis* Taylor: BYU 16926, collected at Maguarichic, Chihuahua, 15 July 1960.

members of the *E. augusti* group. An intertympanic fold is not present.

In the eastern foothills of Sonora and Sinaloa, *E. augusti cactorum* Taylor occurs (Zweifel 1956). It is therefore to be expected in the low valleys of southwestern Chihuahua, as is the case for other species inhabiting the western foothills of the Sierra Madre and thus extending their distribution into the canyons of adjacent Chihuahua.

Family Hylidae

Genus *Hyla* Laurenti

Hyla eximia wrightorum Taylor
Arizona Tree Frog

Hyla eximia Baird, 1854, Proc. Acad. Nat. Sci. Philadelphia 7: 61.

Hyla gracilipes Cope, 1865, Proc. Acad. Nat. Sci. Philadelphia 17: 194.

Hyla wrightorum Taylor, 1939, Univ. Kansas Sci. Bull. 25: 436.

Hyla eximia wrightorum: Schmidt, 1953, A checklist N. Amer. Amph. and Rept., Amer. Soc. Ichthyologists and Herpetologists, p. 71.

3 mi N Chuhuichupa 19 (BYU 13800–1, 14512–17, 15411–12, 15482–84, 15728–29, 15733–36).

Black Canyon, 8 mi W Chuhuichupa, 5 (BYU 14549–53).

26 mi W San Juanito, on road to Maguarichic, 2 (BYU 16958–9).

1 mi W La Laja, 1 (BYU 16871).

1 mi SE Creel, 22 (BYU 15615–15636, 17078–9).

4 mi SE Creel, 2 (BYU 14518–19).

22.5 mi S Creel (La Bufa road), 1 (BYU 16946).

Cerocahui, 3 (BYU 15498–15500).

El Norte, 3 mi N Chuhuichupa, 7 (UAZ 35098–04).

1.4 mi SE Madera, 1 (UAZ 34469).

2.1 mi N Cuachochic, 1 (UAZ 46816).

Basaseachic, 1 (UAZ 46966).

Continental Divide, Sierra Verde, W of Casas Grandes, 1 (UAZ 13509).

In recognizing this taxon as a subspecies, I am following Schmidt (1953). An examination of the entire *eximia* complex may indicate full species status for *wrightorum*. This species distribution from Arizona to south central Mexico warrants careful study.

In the mountains of western Chihuahua this frog was observed at nearly all collecting stations during the rainy season. The ground color is green with a few round to oblong brown spots on the body. A brown stripe extends from snout through nostril to eye and from eye above the tympanum and terminating on body above the front legs. Hind legs have spots and reticulations. The largest specimen was 35 mm in snout-vent length, with most other adults at about 30 mm.

Hyla arenicolor Cope
Canyon Tree Toad

Hyla affinis Baird, 1854, Proc. Acad. Nat. Sci. Philadelphia 7: 61 (preoccupied by *Hyla affinis* Spix 1824).

Hyla arenicolor Cope, 1866, J. Acad. Nat. Sci. Philadelphia, Ser. 2, 6: 84. Type locality, northern Sonora.

Hyla copii Boulenger, 1887, Amer. Mag. Nat. Hist., Ser. 5, 20: 53.

Upper Fork Nutria Creek (near Chihuahua-Sonora line), 1 (BYU 13489).

Río Bavispe, below Tres Ríos, 3 (BYU 13434, 13445, 13449).

Chuhuichupa, 1 (BYU 15410).

Los Chales, 23 mi NE Tres Ríos, 1 (BYU 154703).

Along valley road approx halfway between Babicora and Gómez Farías, 9 (BYU 15494–97, 15501, 15568–70, and 14762).

1 mi W La Laja, 5 (BYU 16866–70).

Maguarichic, 5 (BYU 16931–35).

10 mi SW San Juanito, 1 (BYU 17080).

Cerocahui, 17 (BYU 14579–93).

2 mi SE Creel, 17 (BYU 15601–14, 15803–05).

22 mi S Creel, on road to La Bufo, 1 (BYU 16945).

Río Urique, near Carmen bridge, 40 mi SE Creel, 3 (BYU 31984–86).

Along Río Urique below Carmen Bridge 3–10 mi, 7 (BYU 22712–18).

Mouth of Arroyo del Creel at Río Urique, 1 (BYU 22720).

10 mi below Guachochic, 1 (BYU 22645).

10 mi above Pitahaya Pueblo on Río San Miguel, 3 (BYU 22639–41).

Río San Miguel near Tubares, 3 (BYU 22625–27).

Napuchic (ca 30 km N La Bufa), 5 (UAZ 31235–39).

2 mi S Creel, 11 (UAZ 31240–50).

6 mi E Yepomera, 3 (UAZ 34475–7).

11.2 mi NW Yepomera, 1 (UAZ 34481).

10.5 mi NW Yepomera, 1 (UAZ 34985).

Sierra del Nido, 1 (UAZ 42440).

0.7 mi N Loreto, 1 (UAZ 46613).

Basaseachic Parque Nacional, 1 (UAZ 46965).

This species is widespread in the mountains of western Chihuahua. We did not find it in the valleys east of the Sierra Madre except in the higher valleys such as the one southeast of Babicora and southwest in the general area of Yepomera.

In March of 1971, John Cross explored, by boat, the Río Urique from Arroyo Pamachic (SSW Creel) to Urique. The canyon for most of this distance is deep and in some places has sheer walls (see figures in Tanner 1985). In the mouths of some of the side canyons, or arroyos, are small side pools occupied by amphibians. Along the river, in small gravel and soil banks, are found the same types of vegetation as those present at Urique.

Family Ranidae

Genus *Rana* Linnaeus

Rana pipiens Schreber
Leopard Frog

Rana pipiens Schreber, 1782, Der Naturforscher 18: 185, pl. 4.

Colonia Dublan, 3 (BYU 301, 3657, 22115).

Río Bavispe (below Tres Ríos), 17 (BYU 13477–86, 13439, 13593, 14555–57, 14563–64).

Chuhuichupa, 7 (BYU 13947, 15724–27, 15731–32).

Upper Forks, Nutria Creek, 1 (BYU 13492).

14 mi SE Nuevo Casas Grandes, 9 (BYU 13374-80, 14127, 15456).

Cerocahui, 9 (BYU 14567–75).

Cuiteco, 5 (BYU 14530, 15662, 15775, 15779–80).

San Pedro, on Río Papigochic, 3 (BYU 14524–26).

Urique, 2 (BYU 14365–66).

Los Chales (23 mi NE Tres Ríos), 8 (BYU 15695–02).

2 mi SE Creel, 1 (BYU 15637).

Maguarichic, 7 (BYU 16938–44).

25.5 mi SE Creel (La Bufa Rd), 6 (BYU 17052, 17129–33).

Bocoyna, 1 (BYU 17097).

Springs at Guachochic, 5 (BYU 22648).

Basihuare, 1 (BYU 22702).

10 mi E Pitahaya Pueblo, 1 (BYU 22648).

SW Chihuahua Arroyo C. Prieta (Río Urique), 1 (BYU 22638).

8 mi N Basihuare, 2 (BYU 22633–34).

Barranca Colorado, 1 (Río Urique) (BYU 32267).

Head water Río Conchos (Rosabeachic), 4 (BYU 32010–13).

SW Chihuahua, Arroyo Damachic (Río Urique), 1 (BYU 39363).

SW Chihuahua, Arroyo San Canedaro (Río Urique), 1 (BYU 39372).

This is without a doubt the most widespread and common amphibian in the mountains of western Chihuahua. Webb and Baker (1984) report it from the Cerro Mohinora region, Smith et al. (1963) collected it from five localities along the Río Conchos (Julimes to Cuchillo Parado), and we saw individuals in a deep roadside pool on the north edge of Ciudad Camargo.

Three ranid species occur in Chihuahua. *Rana pipiens* is found throughout the state except in the desert valleys where aquatic habitats do not exist. However, they may be found at permanent springs that are isolated in desert valleys. *Rana tarahumarae* was found only in southwestern Chihuahua and the bullfrog along the Río Casas Grandes, at least from Rancho San Diego north.

I am making no attempt to specify a subspecies that may occur in the diverse *R. pipiens* assemblage. A comprehensive study to determine which subspecies occur is beyond the scope of this study. Until such a study is made, it appears best to list it as the *Rana pipiens* complex.

Rana tarahumarae Boulenger
Tarahumare Frog

Rana tarahumarae Boulenger, 1917, Amer. Mag. Nat. Hist., Ser. 8, 20: 416–17; Zweifel 1968: 66 1–2.

14 mi NE Cuiteco, 4 (BYU 15659–63).

25.5 mi S Creel (along La Bufa Rd), 2 (BYU 17115–16).

Maguarichic, 13 (BYU 16917–25, 16927–30).

SW Chihuahua, Arroyo Hondo (Río Urique), 1 (BYU 39371).

6 km WNW Ocampo, 3 (UAZ 47401–2, 47237).

Boulenger (1917) described this species from "several specimens, from Ioquiro and Barranca del Cobre, Sierra Tarahumare, N.W. Mexico . . . part of a collection presented by Dr. H. Gadow." In the collection of Dr. Irving W. Knobloch there were five specimens from Mojarachic.

This is a larger frog than *Rana pipiens* and appears to be more aquatic. We found specimens only along permanent streams and ponds, even during the rainy season in late July. Boulenger summarized the relationship of this frog as follows: "This species is very closely allied to *R. boylii*, differing in the larger eye, more oblique loreal region, the more distinct tympanum, shorter tibia and the absence of vocal sacs."

It appears that the isolation of *R. tarahumarae* in mountain refugia of the southwestern United States and northwestern Mexico is a direct result of the desiccation that occurred at the close of the Pleistocene period. As with other species that were widespread in the valleys of southwestern North America, these populations were slowly separated and isolated as the developing deserts restricted them to mountain habitats.

Rana catesbeiana Shaw
Bullfrog

Rana catesbeiana Shaw, 1802, Gen. Zool. 3: 106.

4.5 mi S Las Palomas, 3 (BYU 17011–13).

1.3 mi NW Nuevo Casas Grandes, 1 (UAZ 34468).

Bullfrogs were seen at the junction of Juarez Creek and Río Casas Grandes. This was a few miles north of Rancho San Diego. We also observed them around a pond 9.7 miles north of Meoqui. Conant (1974 [1977]) reports them along the lower Río Casas Grandes (6 miles north of Janos).

Family Microhylidae
Genus *Microhyla* Tschudi
Microhyla olivacea Hallowell
Great Plains Narrow-mouthed Toad

Engystoma olivaceum Hallowell, 1856 (1857), Proc. Acad. Nat. Sci. Philadelphia 8: 252.

Gastrophryne olivacea: Smith, 1933, Copeia 1933: 217.

Microhyla olivacea: Parker, 1934, Monograph of the Frogs of the Family Microhylidae 1934: 127–144.

Río Santa María, above the bridge on Hwy 10, 1 (BYU 15277).

Moris (west central Chihuahua), 2 (UAZ 46969 and 46972).

Smith and Taylor (1948) also report this species from the Río Santa María. Smith, Williams, and Moll (1963) collected four specimens from pools near the Río Conchos at Beneficio.

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Those individuals listed in the report entitled Lizards and Turtles of Western Chihuahua (Tanner 1987) were also involved in field studies or aided in providing additional data for this report. Their contributions, although not repeated, were important in assembling the specimens and data now at the M. L. Bean Life Science Museum (BYU).

I am indebted to Dr. Charles H. Lowe for the opportunity to examine the specimens from Chihuahua at the University of Arizona and to report the finding of *Pseudoeurycea belli* in Chihuahua. The University of Arizona collection (UAZ) added considerably to the number of specimens and species included and added to their distribution within Chihuahua. I am particularly grateful for the privilege of examining the adult salamanders that provided the necessary data to describe not only the larval stage but also the adults of *Ambystoma r. rosaceum*. I am also indebted to the following for locality data, loan of specimens, or geographical information: Mr. John L. Cross, who not only provided specimens but also aided in locality information for areas in the barrancas of southwestern Chihuahua; Drs. R. G. Webb and C. S. Lieb, who provided specimens and locality records for central and southern Chihuahua (UTEP); Dr. R. W. McDiarmid and Robert Reynolds, who loaned specimens from the U.S. National Museum (USNM); Dr. D. B. Wake, who loaned specimens from the University of California, Berkeley (MVZ); Dr. H. I. Snell, who loaned specimens from New Mexico (UNM); and J. W. Wright, Los Angeles County Museum (LACM), who loaned specimens.

Specimens were examined from the University of Illinois, University of Kansas, the U.S. National Museum, and the California Academy of Science. For these many opportunities, I am most grateful.

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I am grateful to Dr. Irving W. Knobloch for data and information sent to me concerning his and Mrs. Knobloch's herpetological collections made primarily at Mojarachic and Maguarichic, but with other localities listed for Chihuahua. The first collections were made in the late 1930s (1939). These specimens were given to E. H. Taylor, who reported them in a conjoint paper in 1940. From this collection five new taxa were proposed by Taylor (1940, *Eleutherodactylus tarahumaraensis* and *Lampropeltis knoblochi;* 1941, *Ambystoma rosaceum* and *Ambystoma fluvinatum;* 1944, *Crotalus semicornutus*). There were at least 84 specimens in this collection that were added to the E. H. Taylor–H. M. Smith Collection. These specimens are at the University of Illinois (one-third) and Field Museum of Natural History (two-thirds).

Also among the data sheets are two additional collections. One made in 1954 contains 80 specimens collected at Maguarichic, Mojarachic, and a few from Texas; the second, made in 1957, contains 81 specimens from Chihuahua and Texas. These were apparently deposited at the University of Michigan. Letters from Norman Hartweg (1958) and Charles F. Walker (1962) list 29 species for the two collections. A list of 244 specimens (Knobloch No. 3901-4155), with some having the University of Michigan (UMMZ) catalog numbers (117755–117795), indicates that the larger part of the Knobloch collections is at the Michigan Museum. These collections consisted of: 9 species of amphibians, 1 turtle, 11 lizards, and 11 snakes, most of them collected in the mountains of west central Chihuahua, Mexico.

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